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PHYSICS ABSTRACTS

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Published by The Institution of Electrical Engineers

SECTION A OF SCIENCE ABSTRACTS *(Section B: Electrical Engineering)*
Edited and issued by THE INSTITUTION OF ELECTRICAL ENGINEERS, Savoy Place, London, W.C.2
Published monthly in association with THE PHYSICAL SOCIETY, THE INSTITUTE OF PHYSICS, THE AMERICAN PHYSICAL SOCIETY, AND THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Co-operating members of the I.C.S.U. Abstracting Board (International Council of Scientific Unions)

Physics Abstracts

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PHYSICS ABSTRACTS

Volume 60 MARCH 1957 Number 711

MATHEMATICS 51

517.5

1838. THE MAXIMUM OF A DISTRIBUTION- OR SPECTRUM-FUNCTION. W.van der Bijl.
Nature (London), Vol. 178, 691 (Sept. 29, 1956).

If a variable is subjected to a transformation, the modal value of the distribution of the transformed variable does not, in general, correspond to the mode of the original distribution. Examples are given in which errors have arisen through neglect of this fact.

N.L.Johnson

517.5

1839. A NOTE CONCERNING THE DIRAC DELTA FUNCTION. R.A.Johnson.
Proc. Inst. Radio Engrs, Vol. 44, No. 8, 1058-9 (Aug., 1956).

Comparing their Laplace transforms, the four expressions defining the Dirac delta-function are shown to be not equivalent.

R.Syski

517.91

1840. EXTENSION OF FIELD OF APPLICATION OF RELAXATION METHODS OF COMPUTATION. B.E.Knight.
Nature (London), Vol. 178, 433-4 (Aug. 25, 1956).

An outline is given of a relaxation method for solving a pair of field equations arising in the theory of turbulent gas jets. No numerical example is given and a commentary on the proposed method raises doubt as to whether the method would result in convergence to the solution. At best the proposed method is tentative.

L.S.Goddard

518.5 : 681.142 : 621.317.39

1841. A SIMPLIFIED SOLUTION AND NEW APPLICATION OF AN ANALYSER OF ALGEBRAIC POLYNOMIALS. L.Łukaszewicz.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 1, No. 3, 103-7 (1953).

The principle of operation of an analyser for (12th degree) complex polynomials is described. The circuit is the improved version of Bubb's (Abstr. 1384/1952) analyser but is simpler and reduced in size. Adaptation to Fourier analysis and synthesis is also indicated.

R.Syski

ASTRONOMY . ASTROPHYSICS . GEODESY 52

523.11

1842. ACCRETION HEATING IN THE HERBIG-HARO OBJECTS. F.Hoyle.
Astrophys. J., Vol. 124, No. 2, 484-5 (Sept., 1956).

In contra-distinction to Böhm's conclusions (1956) regarding the line emission from the brightest Herbig-Haro object, it is shown that the accretion rate for such an object would be quite capable of maintaining emission at the observed level of intensity.

D.R.Barber

523.161

1843. THE EXTENT AND EXCITATION OF THE LARGE H II REGION IN VELA—PUPPIS. C.S.Gum.
Observatory, Vol. 76, 150-3 (Aug., 1956).

Parts of the H II emission nebulosity of the complex associated with the stars γ^2Vel and ζ Pup have been traced over a region $60^0 \times 30^0$. A rough comparison of observed intensities with the predictions of Strömgren's theory show that excitation of the nebulosity by these stars is a resonable hypothesis. M.W.Ovenden

523.164.08

1844. THE INTERFEROMETRIC STUDY OF BRIGHTNESS DISTRIBUTION IN RADIOASTRONOMY. IV-VI. J.Arsac.
Rev. Opt., Vol. 35, No. 7, 396-413 (July, 1956). In French.

For Pt II-III, see Abstr. 19 (1957). Considers: (i) the case of an aerial array with adjacent dipoles separated by multiples of $\lambda/2$, (ii) the effect of a finite band-pass, (iii) the effects of errors of construction of aerial arrays, and (iv) the effect of the directivity of the individual aerials. Analogies are drawn between radio and optical techniques. Some experimental investigations are discussed, and the conclusions of the series of papers summarized. M.W.Ovenden

523.164.3

1845. IMPULSIVE RADIO SIGNALS FROM THE PLANET VENUS. J.D.Kraus.
Nature (London), Vol. 178, 33 (July 7, 1956).

Burst-like signals on 11 metres have been observed from the planet Venus, using two collinear arrays of six horizontal half-wave elements, one quarter of a wavelength above ground, the two arrays being separated by 426 ft along an E-W axis. The signals appear as a succession of randomly-spaced bursts of short duration (1 sec or less) over periods of several hours. Intense activity was observed on May 23 and May 30, 1956, and it is noted that large solar flares occurred on May 17 and 26. Comparison with the Cygnus A source suggests a peak radiated radio-power flux-density of 8.9×10^{-22} W.m^{-2} (c/s)$^{-1}$. A lightning-discharge phenomenon on Venus of the intensity of the terrestrial variety (or weaker) would provide sufficient power.

M.W.Ovenden

523.164.3

1846. RADIO OBSERVATIONS OF THE PLANET VENUS AT A WAVE-LENGTH OF 11 m. J.D.Kraus.
Nature (London), Vol. 178, 103-4 (July 14, 1956).

On May 30, 1956, a record was obtained on 11 metres which showed impulsive radio signals for Venus lasting for a period of more than 12 hours. A reproduction of this record is given, which shows the well-defined interferometer lobe pattern, and the occurrence of peaks of activity. An analysis of records in February and March gives evidence of impulsive signals with the suggestion of periods of 20, 39, 63 and 90 min. Periods of intense activity during March, 1956 are plotted as a function of time and date, giving some evidence of an 11-day periodicity. M.W.Ovenden

523.164.3

1847. CLASS II RADIO SIGNALS FROM VENUS AT A WAVE-LENGTH OF 11 METRES. J.D.Kraus.
Nature (London), Vol. 178, 159-60 (July 21, 1956).

In addition to the burst-like radio signals received from Venus, a second type of signal (designated Class II) of a more sustained nature, with durations often greatly exceeding a second, has been observed. These signals have a band-width of approx. 2 Mc/s, and audio-frequency modulation (modulation frequencies of 15, 60, 125 and 150 c/s having been noted). The Venusian origin of these signals is demonstrated by the occasional occurrence of echoes by reflection from the Moon, although the time-delays between the reception of the signal and its lunar echo are systematically some 8% greater than the calculated values. The rarity of the lunar echoes is explained by the fact that, for a measurable echo intensity, particular geometrical dispositions of lunar surface features are necessary. M.W.Ovenden

523.164.3 : 523.164.4

1848. AN EXAMINATION OF THE TOTAL RADIO-FREQUENCY RADIATION AT 200 Mc/s. F.Dröge and W.Priester.
Z. Astrophys., Vol. 40, No. 4, 236-48 (1956). In German.

Measurements of galactic plus extragalactic radiation at 200 Mc/s for declinations between -20^0 and $+90^0$ are reviewed, and combined with observations by Allen and Gum (Abstr. 799/1951) to give data for an isophotal map of the complete celestial sphere for this frequency. Absolute temperature measurements are compared with those of Allen and Gum (ibid.), Bolton and Westfold at 100 Mc/s (Abstr. 796/1951) and McGee, Slee and Stanley at 400 Mc/s (Abstr. 2613/1956). A temperature variation of $T \propto \nu^{-2.35}$ to $\nu^{-2.61}$ is deduced, and it is shown that a correction $\sim 25^0$K is sufficient to bring the various absolute temperature scales to a common zero-point. M.W.Ovenden

523.164.4

1849. DISTRIBUTION OF RADIO STARS. J.G.Bolton.
Observatory, Vol. 76, 62-4 (April, 1956).

It is argued that an apparent excess of faint radio stars can appear in observations made under conditions where the dispersion in absolute brightness or the random error of observation increases with decreasing apparent brightness. M.W.Ovenden

523.164.4

1850. THE RADIO SOURCE NEAR THE GALACTIC CENTRE. B.Y.Mills.
Observatory, Vol. 76, 65-7 (April, 1956).

Isophotes in intervals of 1000^0K brightness temperature are given for the region $324^0 < l < 333^0$, $-6^0 < b < +4^0$, on a wavelength of 3.5 m from observations with a cross aerial with a pencil beam of width 50'. The observations of the region in the direction of the galactic centre are consistent with a model in which an H II region absorbs some of the radiation from an extended flattened source which is not obviously related to any known galactic stellar component. M.W.Ovenden

523.164.4

1851. THE NATURE OF THE RADIO SOURCE IN THE DIRECTION OF THE GALACTIC CENTRE. R.D.Davies.
Observatory, Vol. 76, 196-200 (Oct., 1956).

A further study of published observations of the radio source 17S2A over a wide range of frequencies leads to the conclusion that its spectrum between 9.15 and 3200 Mc/s and its change of shape and position with frequency may be understood in terms of radiation from an H II region lying in front of the bulk of the galactic background emission. M.W.Ovenden

523.164.42 : 523.841.11

1852. THE IDENTIFICATION OF THE MOST POWERFUL DISCRETE SOURCES OF RADIO-EMISSION OF THE GALAXY WITH THE REMAINS OF SUPERNOVA STARS, WHICH HAVE FLARED-UP IN THE LAST 2000 YEARS. I.S.Shklovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 417-20 (1954). In Russian.

Consideration of a fair number of radio-sources leads the writer to distinguish two types. The stars of the first type are relatively few in number and include all the powerful sources concentrated towards the galactic plane and identifiable with supernovae. The second type show no tendency to concentration towards the galactic plane and generally they appear to be of small power. The same classification was arrived at about the same time by Mills (Abstr. 6994/1952). The present paper goes on to examine the various chronicles of flares-up of supernovae and over the last 2000 years all such phenomena appear identifiable with presently radio-emitting nebulae. A useful table of these is given. It is suggested that two problems merit investigation: (a) to look optically for an emitting filamentary nebula, the remains of the supernova of 827 A.D., and (b) to search for discrete sources in the region of the well-known filamentary nebula in Cygnus, the remains of a supernova which occurred relatively close to the Sun about 10 000 years ago. C.R.S.Manders

523.164.42

1853. RADIO EMISSION FROM THE EXTRAGALACTIC NEBULA M87. J.E.Baldwin and F.G.Smith.
Observatory, Vol. 76, 141-4 (Aug., 1956).

Interferometric measurements on 3.7 m show that the radio source IAU 12N1A (associated with the EO galaxy M87) has an extended area of diameter $\sim 1^0$, upon which is superimposed a brighter source of dimensions $\sim 5'$. M.W.Ovenden

523.164.42

1854. THE RADIO EMISSION SPECTRA OF FOUR DISCRETE SOURCES AND OF THE BACKGROUND RADIATION. R.Adgie and F.G.Smith.
Observatory, Vol. 76, 181-7 (Oct., 1956).

Numerical data based upon observations with receivers calibrated against thermal noise sources are given for the Cassiopeia A, Virgo A, Taurus A and Cygnus A sources. The spectral indices for the first three sources are sensibly constant with varying frequency, having the values -0.80 ± 0.05, -0.6 ± 0.1 and -0.3 ± 0.1 respectively. For Cygnus A, the spectral index over the approximate range 30 to 3000 Mc/s varies from -0.6 to -1.0 with increasing frequency. The variation of aerial power with right ascension for 38, 81.5 and 175 Mc/s shows that the predominant components of background radiation have the same spectra over the whole sky, spectral index -0.50 ± 0.1. This leads to the belief that a magnetic field of at least 2×10^{-6} gauss extends throughout the spherical galactic halo. M.W.Ovenden

523.164.42

1855. THE MEASUREMENT OF THE DISTANCE OF RADIO SOURCES BY INTERSTELLAR NEUTRAL HYDROGEN ABSORPTION. D.R.W.Williams and R.D.Davies.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 622-36 (July, 1956).

The distance of a radio source can be determined from its absorption spectrum produced by interstellar neutral hydrogen. Three methods have been used to obtain a distance from these data. It can be decided where any source lies within the Galaxy or whether it is extragalactic. A method is also described for obtaining the kinetic temperature of interstellar neutral hydrogen from absorption and emission spectra. The Cygnus source was found to be extragalactic, the Cassiopeia source appears to lie at a distance of between 2.5 and 5.5. kiloparsecs; while the Sagittarius source is about 3 kiloparsecs from the sun in the direction of the galactic centre. A.

523.164.42

1856. THE LOW FREQUENCY SPECTRUM OF THE CYGNUS (19N4A) AND CASSIOPEIA (23N5A) RADIO SOURCES. R.J.Lamden and A.C.B.Lovell.
Phil. Mag. (Eighth Ser.), Vol. 1, 725-37 (Aug., 1956).

The intensities of the radio sources in Cygnus (19N4A) and Cassiopeia (23N5A) have been measured at frequencies of 16.5, 19.0, 22.6 and 30.0 Mc/s by using the 218 ft aperture transit radio telescope at Jodrell Bank. The main feature of the results is the abrupt fall in intensity of both sources at frequencies below 22 Mc/s. Possible causes of this behaviour are discussed and it is shown that the effect is probably due to absorption of the radiation in an interstellar H II region of average density and extent. A.

523.42

1857. ROTATION PERIOD OF THE PLANET VENUS AS DETERMINED BY RADIO OBSERVATIONS. J.D.Kraus.
Nature (London), Vol. 178, 687-8 (Sept. 29, 1956).

A probable rotation period of 22 hr 17 min $\pm$ 10 min is found from 11 metre observations at Ohio, U.S.A. D.R.Barber

523.7

1858. THE SUN'S GENERAL MAGNETIC FIELD. H.Alfvén and B.Lehnert.
Nature (London), Vol. 178, 1339 (Dec. 15, 1956).

Babcock and Babcock's deduction of a general solar field of the order of -1 gauss is criticized on the grounds that, since a "point" for the measurement of Zeeman effect in the experiments covers several granulae, the assumption has to be made that the effect of magnetoturbulence is small. A simple example is given suggesting that this assumption is invalid. The absence of "bias" in the observations is no guarantee that the observations are unaffected by magnetoturbulence. M.W.Ovenden

523.7 : 538.08

1859. A SOLAR MAGNETOGRAPH. D.W.Beggs and H.von Klüber.
Nature (London), Vol. 178, 1412 (Dec. 22, 1956).

The Zeeman effect of a suitable Fraunhofer line is analysed with an ammonium di-hydrogen phosphate plate and a fixed Polaroid, the retardation of the plate oscillating in sign, due to an applied voltage, at 400 c/s. A selected portion of each wing of the line is fed into a photomultiplier, the outputs of the two photomultipliers being fed into a difference amplifier (thus rejecting any elliptical polarization due to the coelostat mirrors) and then into a selective-frequency amplifier. Doppler shifts are then relatively unimportant. A wealth of magnetic fine structure on the solar surface is revealed,

and localized fields of up to 100 gauss can be observed in regions of the photosphere apparently undisturbed in white light. The magnetic fine structure is probably appreciably finer than the angular resolving power of the spectrograph in its present form, and may be comparable with the Doppler fine structure recently discovered. The instrument can be adapted to measure Doppler shifts equivalent to a small fraction of 1 km/sec. M.W.Ovenden

523.72

1860. HIGH-ENERGY PARTICLES IN SOLAR FLARES. T.Gold.
Nature (London), Vol. 178, 487 (Sept. 1, 1956).

Recent Russian experiments show that in the complex processes occurring in magnetically-constricted spark discharges there is a mechanism capable of accelerating a small fraction of excited particles to energies substantially higher than those predicted from the values of temperature and potential difference associated with the discharge. To account for the high-energy particles known to be produced in solar flares, a similar mechanism is invoked.

D.R.Barber

523.74

1861. SOLAR ATMOSPHERIC HEATING AND FLARES.
J.H.Piddington.
Observatory, Vol. 76, 21-3 (Feb., 1956).

A qualitative discussion of observed heating effects, based on recent extensions of hydromagnetic-wave theory involving frictional energy loss between an ion plasma and a neutral atom gas.

R.A.Newing

523.755

1862. THE NATURE OF THE SOLAR CORONA AND OF THE PROMINENCES. M.N.Gnevyshev and R.S.Gnevysheva.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 639-41 (1954). In Russian.

The authors consider that active regions arise on the sun with the appearance of magnetic and electric fields. These latter may come about as the result of strong eddy or vortex motion of charged matter in the photosphere and below. It is possible that the appearance of prominences is associated with brief increase of the magnetic field in an active region, large masses of material being ejected from the chromosphere. These masses either describe trajectories along the lines of force or, with falling off of the electromagnetic field, become dispersed. The authors find themselves in agreement with Shklovskiĭ (Solar Corona, I.S.Shklovskiĭ, Moscow, 1951, p. 367) who accounts for the high coronal temperatures by the acceleration of low-density electron gas to high velocities by electric fields.

C.R.S.Manders

523.77

1863. OBSERVATIONS OF THE INTENSITY OF SOLAR LYMAN-ALPHA EMISSION. E.T.Byram, T.A.Chubb, H.Friedman and J.E.Kupperian,Jr.
Astrophys. J., Vol. 124, No. 2, 480-2 (Sept., 1956).

Absolute intensity measurements of solar Lyman-α radiation made with rocket-borne equipment during 1949-55 show a sudden increase towards the end of 1955 which may be an effect of the waxing sun-spot cycle. D.R.Barber

523.823

1864. THEORETICAL FORMULAE FOR THE STELLAR "MASS–LUMINOSITY" AND "MASS–RADIUS" RELATIONSHIPS. L.I.Sedov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 643-6 (1954). In Russian.

Following the Strömgren approach to finding the relationship between the radius, luminosity and mass of a star on the basis of the equilibrium equations, the author introduces three new variables in the latter and derives relationships which are particularly suitable for the treatment of observations. C.R.S.Manders

523.85 : 523.82

1865. POLARIMETRIC INVESTIGATIONS OF NEBULAE M8 AND M20 AND OF STARS IN THEIR NEIGHBOURHOOD.
V.A.Dombrovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 105, No. 5, 924-7 (1955). In Russian.

Results taken during August–September 1954 are compared with results for stars. Only HD 164514 shows a degree of polarization as large as that found in the luminous cloud regions of the nebulae. J.M.Hough

523.852

1866. THE ELECTRONIC DENSITIES OF EIGHT GASEOUS NEBULAE AS DEDUCED FROM THE INTENSITY RATIO OF THE [O II] LINES. H.Andrillat.
C.R. Acad. Sci. (Paris), Vol. 243, No. 8, 702-4 (Aug. 20, 1956). In French.

Intensity ratios of the 3726 and 3729 A lines, have been measured for N.G.C. II 2149, 2392, 6210, 6543, 6572, 6720, 7027 and Orion, by photographic spectrophotometry of one-prism spectra taken in February, March and June 1956. The results agree well with the theoretical value of the ratio deduced from the electronic density, and temperature of the nebula. For N.G.C. 6720, the electronic density is relatively weak; a result to be expected from the observed values of total surface-brightness in H_β light, and the Balmer discontinuity for this object. D.R.Barber

523.852

1867. THE ORIENTATION IN SPACE OF THE FILAMENTS OF CERTAIN GAS–DUST NEBULAE. V.G.Fesenkov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 647-50 (1954). In Russian.

It is not usually possible to judge the space orientation of these filaments, which are of interest in cosmogony, for the region of radio-emission lies only a degree or two on either side of the plane of the galactic equator. A careful study has been made of the filamenous structure of nebula NGC 6992-5 which shows that the direction of the filaments makes an angle of about 75^0 with the galactic radius. C.R.S.Manders

523.852.22

1868. THE ELECTRONIC TEMPERATURES OF THE PLANETARY NEBULAE. H.Andrillat.
Ann. Astrophys. Suppl., No. 1, 1-58 (1955). In French.

Based on the spectrophotometric results for 31 planetary nebulae, the following conclusions are reached: (1) a range of electronic temperature between 8000 and 27 000°K is found, the observed temperature being correlated positively with the degree of ionization within the nebula; (2) there exists to the violet of the strong Balmer discontinuity, a second weak drop at 3450 A, caused by recombination of neutral He atoms at the 2q level; (3) confirmation is found of the role played by de-excitation by collision of H atoms at the 2s level in the 2q continuum emission; (4) the possible existence of an envelope of neutral H around certain nebulae, rendered visible by the 2q continuum emission. D.R.Barber

525.73

1869. DIRECT OBSERVATION OF ELEMENT MOTION IN STELLAR SHADOW PATTERNS. P.E.Barnhart, W.M.Protheroe and J.Galli.
J. Opt. Soc. Amer., Vol. 46, No. 10, 904-5 (Oct., 1956).

Photoelectric observations with dual telescopes of the auto-correlation function of brightness variation of the shadow pattern from Arcturus, made at the Perkins Observatory, Ohio on 19-20 May 1956, indicated a translational motion of the pattern with a velocity of 38 ± 3 knots in a direction, 300 ± 3 degrees, in good agreement with balloon observations of the upper wind between 10 000 and 40 000 ft on the same bearing. An altitude of 32 000 ft is suggested for the turbulent, pattern-producing zone. D.R.Barber

529.78 : 621.317.39

1870. THE NEW SECRETAN PRINTING CHRONOGRAPH. (ITS USE IN THE TIME SERVICES OF THE ROYAL OBSERVATORY OF BELGIUM). J.Verbaandert.
Ann. Franç. Chronom., Vol. 10, No. 3, 189-99 (1956). In French.

A description of a new printing chronograph which attains a precision ~ 0.001 sec. M.W.Ovenden

529.786

1871. DEFINITION OF THE SECOND OF TIME. G.M.Clemence.
Nature (London), Vol. 176, 1250 (Dec. 24, 1955).

Refers to Bullard's suggestion (Abstr. 104/1956) to abandon the astronomical second and adopt a "physical second" and directs attention to two consequences (a) that by using the atom as a standard of length and of frequency the units of length and time lose their independence; and (b) that since an atom is not a natural clock, one kind of second would be used for measurements of frequency and another for actual time keeping. S.Weintroub

529.786

1872. THE STANDARD OF LENGTH AND THE STANDARD OF TIME. A.Pérard.
Nature (London), Vol. 177, 850-1 (May 5, 1956).

Comments on the article by Clemence (preceding abstract), and mentions that Clemence mistakenly confused the micron with the angström as the length which is subject to experimental determination. The metre as defined in terms of wavelength, using the wavelength of the red Cd line as $0.643\,846\,96 \times 10^{-6}$ m, is strictly equal to the metre defined by means of the Pt–Ir prototype and thus though the standard is changed the unit of length is not. The hope is expressed that the same will occur for the unit of the interval of time. The unit should be defined in terms of the astronomical second, the frequency

N of an atomic standard being given by Nt = (1/31 556 925.974 74) tropical year for 1900.0. The standard of interval of time will thus be changed from the tropical year to t, but the unit will be unchanged. The unit of length and the unit of time will then no longer be independent. S.Weintroub

529.786

1873. ATOMIC TIME AND THE DEFINITION OF THE SECOND. L.Essen.
Nature (London), Vol. 178, 34-5 (July 7, 1956).

It is pointed out that the second of ephemeris time is internationally recommended for precise work, but to obtain an accuracy of ± 5 parts in 10^{10} which is used in frequency measurements, astronomical observations would have to extend over ten years. Thus, the second of ephemeris time can be made available with the required accuracy only by using an atomic standard for interpolation purposes. Considering the correlation of the two units the author prefers with Pérard (preceding abstract) for the authorities to make available a single unit of time, but suggests that provisionally the time unit should be 1 provisional second = time of 9 192 631 830 cycles of the Cs Fm, (4, 0) ↔ (3, 0) resonance at zero field; that the N.P.L. and the U.S. Naval Observatory should continue to obtain the value of the Cs frequency in terms of the second of ephemeris time for a period of (say) five years when the precision should then be 1 part in 10^9; and that then this new frequency be adopted as the definition of the second. S.Weintroub

PHYSICS 53

FUNDAMENTALS 530.1

530.12 : 531.51 : 532.5

1874. GRAVITATIONAL WAVES AND ONE-DIMENSIONAL EINSTEINIAN GAS DYNAMICS. G.C.McVittie.
J. rational Mech. Anal., Vol. 4, 201-20 (1955).

Gravitational waves are said to exist when the field equations in empty space–time have time-dependent solutions which satisfy the wave equation. The problem of the existence of such waves is investigated. Mathematical Reviews

530.12

1875. ON ISOTHERMAL COORDINATES IN UNIFIED THEORY. F.Maurer-Tison.
C.R. Acad. Sci. (Paris), Vol. 243, No. 17, 1196-8 (Oct. 22, 1956). In French.

The Ricci tensor is expressed in isothermal coordinates (Abstr. 2392/1955) and a third-order approximation gives an analogue in the Einstein–Schrödinger theory of the energy-momentum tensor of general relativity. R.A.Newing

530.12

1876. CONSERVATION CONDITIONS FOR THE ENERGY–MOMENTUM TENSOR IN THE EINSTEIN–SCHRÖDINGER UNIFIED THEORY. Pham Tan Hoang.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1600-3 (Nov. 19, 1956). In French.

The equations $R_{\alpha\beta} = 0$ are used to introduce an energy–momentum tensor $T_{\alpha\beta}$. The metric tensor is taken to be $(h/g)^{1/2}h^{\alpha\beta}$, where $h^{\alpha\beta}$ is the symmetric part of $g^{\alpha\beta}$, and it is shown that $T_{\alpha\beta}$ is conservative if $R_{\alpha\beta} = 0$. R.A.Newing

530.12 : 531.51

1877. OLD PROBLEMS IN THE GENERAL THEORY OF RELATIVITY VIEWED FROM A NEW ANGLE. C.Møller.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 10, 28 pp. (1955).

A 3-vector development of particle dynamics is given for a particle moving in a gravitational field with potential χ, the Lorentz factor being replaced by the generalized factor $\Gamma = [1 + 2\chi/c^2 - u^2/c^2]^{-1/2}$. The results are applied in discussions of the harmonic oscillator and the gravitational red-shift of spectral lines, results for the latter being derived directly from consideration of the changes in atomic energy levels due to a gravitational field. Careful consideration is given to the concept of an ideal standard clock, and the possibility of constructing a mechanical model is discussed. It is shown that, with appropriate approximations, the period of such a model is consistent with the relativistic formula for proper time $d\tau = \Gamma^{-1}dt$. R.A.Newing

530.12 : 531.18

1878. SUGGESTED EXPERIMENT ON THE RELATIVISTIC CONTRACTION OF TIME. R.Herman.
Nature (London), Vol. 178, 689 (Sept. 29, 1956).

It is suggested that unstable charged particles of known half-life be injected into a synchrotron. Any increase in the life of the particles could be detected by comparing the number of particles entering with the number of emerging per unit time. R.A.Newing

530.12

1879. COSMIC TIME AND THE FIELD EQUATIONS OF GENERAL RELATIVITY. W.Kantor and G.Szekeres.
Phys. Rev., Vol. 104, No. 3, 831-4 (Nov. 1, 1956).

General relativistic field equations in the presence of a scalar cosmic time field have been obtained by one of the authors previously (Abstr. 1497/1955); other possibilities are discussed in this paper. The central problem is to construct a suitable Lagrangian density from the cosmic time field and the metrical field. As there is no physical theory on which to base this construction, it is necessarily speculative. A certain "gauge postulate" is applied to reduce the number of possible constructions to a reasonable level; further simplifying assumptions on the general form of the Lagrangian lead essentially to one new alternative which is discussed here in some detail. A.

530.12

1880. VARIATION OF INTEGRALS AND THE FIELD EQUATIONS IN THE UNITARY FIELD THEORY. H.A.Buchdahl.
Phys. Rev., Vol. 104, No. 4, 1142-5 (Nov. 15, 1956).

It is first shown how in the unitary field theory one may obtain the Hamiltonian derivatives of various Lagrangians directly, i.e., without the use of Palatini's device, the relation $g_{i\,k;l}^{+\,-} = 0$ being postulated. According to the choice of Lagrangian and of subsidiary conditions, the vanishing of the variation of an action integral then yields a variety of sets of field equations, one of which may be regarded as the conjugate of Einstein's set Ib. The latter implies in first approximation a restriction upon the current vector (as customarily defined) which does not appear tenable. Alternative field equations are therefore proposed which imply no such restriction in the linear approximation. The quasi-linear approximation however reveals a joint restriction upon the "gravitational and electromagnetic" field components which in turn cannot be regarded as permissible. A.

530.12

1881. A PROBLEM IN RELATIVITY THEORY. H.Dingle.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 925-34 (Dec., 1956).

The paper analyses a form of the familiar "clock paradox", in which two observers separate and re-unite, but in which the accelerations normally necessary at starting, reversing and stopping are eliminated, so that the problem lies wholly within the scope of the special theory of relativity. The importance of the problem lies in the fact that it embodies all the essential principles of that theory, about which recent correspondence in "Nature" has shown much disagreement to exist. The points specially brought out are the following: (1) The theory is not basically concerned with a comparison between different observers but between different coordinate systems which are available to a single observer. (2) It is not basically concerned with a comparison between stationary and moving systems but between descriptions of a single system with respect to different arbitrarily chosen standards of rest. (3) The familiar expression, "time retardation", does not relate to a physical change experienced by a clock but to a comparison of times of an event by two clocks, at least one of which is not present at the event. When both are present the discrepancy vanishes. A similar remark applies to the "Lorentz contraction" of moving rods. A.

530.12

1882. A PROBLEM IN RELATIVITY THEORY — REPLY TO H.DINGLE. W.H.McCrea.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 935 (Dec., 1956).

530.145 : 548.7

1883. INTERMEDIATE COUPLING INTERACTION OF A NON-RELATIVISTIC PARTICLE WITH A SCALAR FIELD. II. G.Höhler.
Z. Phys., Vol. 146, No. 3, 372-88 (1956). In German.

Using the Pekar functions of Pt I (Abstr. 4371/1955), the energy of the ground state is expanded in descending or ascending powers of the coupling parameter g. With strong coupling, the mass of the polaron is, to the order g^6, half Pekar's value, and the correction of the g^4-term may be large. W.A.Hepner

530.145

1884. PROBLEM OF GHOST STATES IN FIELD THEORIES. K.W.Ford.
Phys. Rev., Vol. 105, No. 1, 320-7 (Jan. 1, 1957).

It is shown that the ghost problem in the Lee model cannot be circumvented by using a renormalized integral equation as a basis instead of the Hamiltonian formulation. This equation (the Low equation) possesses no solutions for coupling constants larger than the critical value, and an infinite family of solutions for coupling constants smaller than the critical value. The Low equation for the Lee model is also mathematically equivalent to an exact integral equation for the boson propagator in relativistic field theory, and permits one therefore to describe the properties of possible ghosts in a relativistic theory in terms of already known properties of Lee-model ghosts. There exists an interesting symmetry between this integral equation and its solution, both of which have the form of dispersion relations. The excellent experimental tests of quantum electrodynamics provide no evidence that the theory is free of the ghost problem. A.

530.145

1885. SPECTRAL REPRESENTATION OF THE GREEN'S FUNCTION IN THE NON-RELATIVISTIC MANY-BODY PROBLEM. V.L.Bonch-Bruevich.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 522-3 (1956). In Russian.

The components of the Green's function G are studied in a mixed (spectral) representation, i.e. after a Fourier transform with respect to time. G.E.Brown

530.145

1886. ON THE EQUATION FOR THE DISTINGUISHED COMPONENT OF THE STATE VECTOR. W.Królikowski and J.Rzewuski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 1, 19-29 (1956).

Defining the distinguished component with the help of projection operators, an integro-differential equation with respect to time is derived, and closed expressions are given for the kernels in the general and in the stationary case. This equation can be replaced by one purely differential with respect to time; in the stationary case this has the form of a Schrödinger equation with complex potential, the imaginary part determining the lifetime. W.A.Hepner

530.145 : 530.12

1887. ON THE THEORY OF QUANTIZED FIELDS IN GENERALIZED RELATIVITY. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 243, No. 14, 939-42 (Oct. 1, 1956). In French.

In previous papers (Abstr. 3475, 4802, 5683-4/1956) it was shown that the theory of quantized fields may be deduced from a double hypothesis of covariance, in the case of the restricted theory of relativity. This hypothesis related to relativistic covariance and covariance with respect to a change of base in Hilbert space. The present note extends the results to the generalized theory of relativity. L.S.Goddard

530.145

1888. QUANTUM FIELD THEORY WITH CAUSAL OPERATORS. Yu.V.Novozhilov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3 (9), 493-503 (1956). In Russian.

The problem of constructing a mathematical formalism for space–time treatment of field theory on basis of the action principle is considered. It is shown that the formalism must necessarily involve the concept of external sources. A.

530.145

1889. ON THE INTEGRALS OF DE BROGLIE'S ELECTROMAGNETIC EQUATIONS. A.Tonolo.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2699-72 (June 4, 1956). In French.

For the previous paper see Abstr. 7114 (1956).

530.145

1890. HIGH ENERGY BEHAVIOUR OF RENORMALIZABLE FIELDS. II. M.Konuma and H.Umezawa.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1461-72 (Dec., 1956).

For previous part see Abstr. 4814 (1956). The asymptotic forms of the many-body propagators are discussed by means of the renormalization invariance. The results show a simple relationship between the many-body and one-body-propagators. The peculiar features of the S-matrix, when the observed value of the coupling constant is out of the normal zone, are discussed. A.

530.145

1891. DETERMINATION OF THE GREEN FUNCTIONS FOR THE BLOCH–NORDSIECK MODEL BY A FUNCTIONAL INTEGRATION METHOD. A.V.Svidzinskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 324-9 (1956). In Russian.

An electrodynamic model is considered in which the Dirac γ-matrix is replaced by constant c-numbers. For such a model vacuum polarization is absent, the Green function equation for an electron in an external field can be solved in quadratures and the Green function with radiative corrections can easily be found by using a functional integration method. After renormalization an explicit analytical expression for the electron Green function is obtained which does not contain infinities. A.

530.145

1892. PHOTON DIFFRACTION RADIATION BY PARTICLES OF SPIN $\frac{1}{2}$. A.I.Akhiezer.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 651-4 (1954). In Russian.

Particles of spin $\frac{1}{2}$, which are diffraction-scattered, undergo a small change in momentum and, consequently, can radiate. The cross-section for this is calculated, and modifications which would arise from a finite opacity are discussed. G.E.Brown

530.145

1893. GENERAL SOLUTION OF THE EQUATIONS OF THE RENORMALIZATION GROUP. L.V.Ovsyannikov.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1112-14 (1956). In Russian.

Analytical solutions of the equations of Bogolyubov and Shirkov (Abstr. 81-2/1957) are obtained. G.E.Brown

530.145 : 539.18

1894. ČERENKOV RADIATION OF NEUTRAL PARTICLES WITH A MAGNETIC MOMENT. N.L.Balazs.
Phys. Rev., Vol. 104, No. 5, 1220-2 (Dec. 1, 1956).

A simple expression is deduced for the Cherenkov radiation caused by magnetic and electric dipoles. The effect is very small. In the visible spectrum for a fast neutron, the energy loss per unit path per unit frequency range is about 10^{-18} times that of a fast electron. The expression for the energy loss does not contain explicitly the mass of the moving particle. Consequently, this method cannot be used to try to detect whether or not the neutrino has any trace of a magnetic moment. A.

530.145

1895. THE ASYMPTOTIC ELECTRON GREEN'S FUNCTION IN THE INFRARED REGION TO AN ACCURACY OF e^4. L.D.Solov'ev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 2, 203-6 (1956). In Russian.

The equations of the renormalization group are solved to give the Green's function to this accuracy. G.E.Brown

530.145

1896. COHERENCE EFFECTS IN THE LEE–YANG PARITY DOUBLET THEORY OF STRANGE PARTICLES. R.Gatto.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1274-84 (Dec., 1956).

It is shown that certain coherence effects occur in the parity doublet theory of strange particles which may give rise to peculiar time and angular dependences in angular correlations. The possibility of observing such effects is closely related to the values of the mass differences in the parity doublets, and it would in fact permit measurement of the mass differences. A condition for the observability of the coherence effects is that the electromagnetic interaction be minimal. Other physical aspects of the theory, such as the time dependence of the decay rates, the lifetimes of hyperons, and the parity doublet structure of hyperfragments, are discussed. A.

530.145

1897. INTRINSIC MOMENTS OF ELEMENTARY PARTICLES. J.Pease and R.L.Pease.
Phys. Rev., Vol. 104, No. 3, 816-21 (Nov. 1, 1956).

A system described by a first-order linear field equation, with matrix coefficients satisfying the general commutation rules of dgree n derived by Bhabha, is assumed to interact with an external electromagnetic field. By manipulation of permutations of the operators involved, a systematic procedure is developed for extracting the intrinsic moments of a system of arbitrary n, such moments are found to exist up to and including 2^{n-1}-pole order. The (covariant) interactions are simplified by considering the system in one of its rest states. An explicit formula for the magnetic dipole moment is derived and compared with the result obtained for a special case by Harish-Chandra. A.

530.145

1898. NEW APPROACH TO THE QUANTUM THEORY OF THE ELECTRON. H.C.Corben.
Phys. Rev., Vol. 104, No. 4, 1179-85 (Nov. 15, 1956).

Expectation operators and total operators are defined for a quantized field theory in a manner analogous to that in which expectation values and total values are defined in an unquantized field theory. From the usual anticommutation relations for the ψ field it is possible to determine the commutation relations between such operators. The quantized theory may then be developed in considerable detail without resource to plane-wave expansions. It is shown that at least one divergence of the standard method — the vacuum charge expectation value — arises from the use of such an expansion. By postulating the usual free-particle quantized Dirac Hamiltonian, it is shown how to construct a state of the field which in the classical limit satisfies Maxwell's equations, and another state which in this limit satisfies the Dirac equation for a neutrino. By introducing internal coordinates for the field which describe the mean square radius and other moments of the charge distribution about its centre, it is possible to write the equation of motion for the quantized field in the form of a differential equation which, if the internal motion is neglected, reduces to the Dirac equation for a state of charge e and to the Kemmer–Duffin equation for a state of charge 2e. A.

530.145

1899. NOTE ON PAULI'S THEOREM CONCERNING THE CONNECTION OF SPIN AND STATISTICS. V.L.Pokrovskiĭ and Yu.B.Rumer.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 337-8 (1956). In Russian.

This can be established by considering only invariance requirements under space–time inversion. G.E.Brown

530.145

1900. THE APPLICATION OF THE TOMONAGA METHOD TO A SCALAR MODEL THEORY. K.Meyer.
Ann. Phys. (Leipzig), Vol. 18, No. 1-2, 104-12 (1956). In German.

Tomonaga's intermediate coupling method is applied to the interaction of a neutral scalar meson field with a source, the recoil being included. P.T.Matthews

530.145

1901. NON-LINEAR MESON FIELD OF A NUCLEON AT REST. A.Borgardt.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1107-8 (1956). In Russian.

Discussion of the qualitative features of solutions of several possible non-linear equations in which the Kemmer β-matrices are used. G.E.Brown

530.145

1902. PSEUDOSCALAR INTERACTION IN NONLINEAR MESODYNAMICS. A.Borgardt.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 42-3 (1956). In Russian.

General properties that a nonlinear equation must have are noted. In the static approximation and for small distances, solutions of three possible equations are given. G.E.Brown

530.145

1903. COUPLED SYSTEMS OF THE MESON FIELD. I.S.Arzhanykh.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 3, 351-4 (1956). In Russian.

Field equations are employed in the Proca form. Two possibilities are considered; either the field has a spectrum of masses, or the field has a spectrum of velocities for a given mass. G.E.Brown

530.145

1904. ON EMERGENCE FROM THE REGION OF WEAK COUPLING IN THE TWO-CHARGE MESON THEORY. I.F.Ginzburg.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 535-8 (1956). In Russian.

Previously (Abstr. 1065/1957), with the renormalization group method, it was shown in the two-charge pseudoscalar meson theory that — for a definite ratio of the charges — the theory goes out of the weak-coupling region at high moments, even if the charges are small. This result is here shown to be valid for an arbitrary ratio of the charges. G.E.Brown

530.145

1905. ON THE POTENTIAL IN THE PAIR THEORY OF NUCLEAR FORCES. Yu.M.Lomsadze.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 545-8 (1956). In Russian.

A relativistic derivation of the potential between two nucleons only gives a worse singularity (r^{-5}, where r is the internucleon distance) than the nonrelativistic one. Renormalization is carried out in the lowest order. G.E.Brown

530.145

1906. A REMARK ON THE RELATION BETWEEN THE SCATTERING PHASES AND THE POTENTIAL. R.Jost.
Helv. phys. Acta, Vol. 29, No. 4, 410-18 (1956). In German.

A procedure is given for the solution, for large r, of the Gel'fand–Levitan equation, under certain conditions. This is used to establish a lemma on the behaviour of the integral of the potential. P.T.Matthews

530.145

1907. THEORY OF S-WAVE PION SCATTERING AND PHOTOPRODUCTION AT LOW ENERGIES. S.D.Drell, M.H.Friedman and F.Zachariasen.
Phys. Rev., Vol. 104, No. 1, 236-48 (Oct. 1, 1956).

A fixed-source analysis of the s-wave pion –nucleon interaction is constructed along the lines of the Chew–Low–Wick formalism. A bilinear s-wave interaction of the form $\lambda_0\varphi\cdot\varphi + \lambda\tau\cdot(\varphi \times \pi)$ is added to the usual p-wave coupling $(4\pi)^{1/2}(f/\mu)\sigma\cdot\Delta\tau\cdot\varphi$. Scattering equations are developed and solved in the one-meson approximation. Values for the renormalized coupling parameters λ_0 and λ are determined which give reasonable agreement with the s-wave phase shifts up to ~ 100 MeV pion kinetic energy. This s-wave interaction with the parameters fixed by the scattering analysis is then applied to the discussion of the π^+ and π^0 photo-production cross-sections. A Kroll–Ruderman theorem is proved for the above nonlocal interaction and it is shown that the contributions to s-wave neutral and charged photoproduction are consistent with experiment. Other experimental implications, in particular as to the possible role of $\pi-\pi$ forces, are discussed. A.

530.145

1908. CONVERGENCE OF THE TAMM–DANCOFF FORMALISM. W.C.Meecham.
Phys. Rev., Vol. 104, No. 3, 825-31 (Nov. 1, 1956).

A sufficient condition for the convergence of the Tamm–Dancoff formalism is shown. The special problem considered is that of describing a single spinless nonrelativistic nucleon in the presence of a neutral scalar meson field. The formalism is seen to converge for the cutoff momentum somewhat less that the rest mass of meson. A.

530.145

1909. RELATIONSHIP BETWEEN THE SCATTERING OF HIGH-ENERGY DIRAC AND KLEIN–GORDON PARTICLES. G.Parzen.
Phys. Rev., Vol. 104, No. 3, 835-8 (Nov. 1, 1956).

Relationships have been found between the scattering of a high-energy relativistic particle that obeys the Dirac equation and one that obeys the Klein–Gordon equation. The phase shifts at high energies are related by $\delta_l = \frac{1}{2}(\eta_l + \eta_{l+1})$, where δ_l and η_l are the Dirac and Klein–Gordon phase shifts, respectively; and the cross-sections are related by $\sigma_D(\theta) = \sigma_K(\theta)\cos^2(\frac{1}{2}\theta)$, where σ_D and σ_K are the Dirac and Klein–Gordon cross-sections, respectively. The errors in these relations are discussed and the results of a numerical calculation using a square well potential are given to illustrate the accuracy of the above relations. A.

530.145

1910. ADIABATIC APPROXIMATION FOR SCATTERING PROCESSES. D.M.Chase.
Phys. Rev., Vol. 104, No. 3, 838-42 (Nov., 1956).

The adiabatic approximation, frequently utilized in treating bound states of quantum-mechanical systems, is shown to be applic-

able also to scattering processes in cases for which the number of excited states of the target contributing significantly to the wave-function is limited, and for which the time of traversal of the scattered particle through the region of interaction is small compared with the period of the target motion excitable in the collision. In this approximation, calculation of partial inelastic cross-sections is reduced to two steps: (1) determination of the elastic scattering amplitude for fixed target coordinates and (2) subsequent evaluation of scalar products in the space of the target. The method is illustrated by means of a simple one-dimensional example. Calculation of cross-sections for nuclear rotational excitation by neutrons is formulated. A.

530.145

1911. DISPERSION RELATIONS FOR FIXED-SOURCE MESON THEORIES. A.Klein.
Phys. Rev., Vol. 104, No. 4, 1131-6 (Nov. 15, 1956).

Dispersion relations for a class of Hamiltonian operators describing meson theories with a fixed, extended source are derived for meson–nucleon scattering. It is assumed that each meson field operator is coupled to its own source, and a restriction is imposed on the maximum number of temporal or spatial derivatives of the field operator that can occur in any one term. On the other hand, the interaction need not be linear in the meson field. With these assumptions, nonrelativistic versions of all proposed relativistic dispersion relations are derived rigorously. In particular, the P-wave equations of Chew and Low are obtained, as well as a set of equations for the S-waves. A.

530.145

1912. DISPERSION RELATIONS FOR FIXED-SOURCE MESON THEORIES: EFFECTIVE-RANGE RELATIONS. A.Klein.
Phys. Rev., Vol. 104, No. 4, 1136-41 (Nov. 15, 1956).

Dispersion relations for boson–fermion scattering have been shown to yield, in the static limit, coupled integral equations for the scattering amplitudes of a definite orbital angular momentum. The present investigation is devoted to the search for the "solutions" of these equations, or more accurately, to the problem of obtaining essentially real integral equations for the reciprocals of the scattering amplitudes, since such equations would form the basis for effective range approximations. The mathematical problem is that of determining an analytic continuation of the scattering amplitudes which has no zeros in the complex plane. It is shown that for all cases considered, an analytic continuation can be defined, either for the scattering amplitude in a definite channel, or for a simple linear combination of these, which has the basic properties of Wigner's R-functions, and which upon inversion yields the required equations. The inverse will, however, contain as many arbitrary constants (or in some instances functions) as there are zeros in the original amplitudes, as has been pointed out previously for simpler examples. It is shown that the procedures apply, without essential change, to the case that inelastic processes are permitted. No attempt is made to apply the resultant formulae to experiment. A.

530.145

1913. VALIDITY OF THE INTERMEDIATE-COUPLING APPROXIMATION. R.Stroffolini.
Phys. Rev., Vol. 104, No. 4, 1146-9 (Nov. 15, 1956).

The internal consistency of the intermediate coupling approximation, applied by Friedman, Lee, and Christian to the meson theory, is discussed critically. It is shown: (a) that the description of low-energy mesons in the cloud is quite unreliable; (b) that the approximation becomes more adequate for high energies, the expression for the ground-state self-energy is much better than the one given by a Tamm–Dancoff method; (c) that the structure of the nucleon as described by intermediate coupling does not give directly any sensible result about scattering; (d) that the agreement found by Friedman, Lee, and Christian between theoretical results and experimental phase shifts follows essentially from the presence of the zero- and one-meson states in the scattering trial function and is not a consequence of any particular choice for the physical nucleon state. A.

530.145

1914. APPROXIMATION METHOD FOR SHORT WAVELENGTH OR HIGH-ENERGY SCATTERING. L.I.Schiff.
Phys. Rev., Vol. 104, No. 5, 1481-5 (Dec. 1, 1956).

See Abstr. 6364 (1956). The approximation method is extended to the scattering theory of Maxwell's equations and of the Schrödinger equation with spin–orbit interaction. Both of these situations are more complicated than the Schrödinger and Dirac cases considered earlier. However, while the electromagnetic case yields the earlier type of result in which the Born formula is modified by the inclusion of an additional phase factor, the Schrödinger spin–orbit case cannot be put in such a simple form. Brief mention is also made of the tensor interaction, which is even more complicated than the spin–orbit interaction, and of the space-exchange interaction, which can be treated by this method only if the potential is symmetric with respect to inversion. A.

530.145

1915. YANG–FERMI AMBIGUITY. W.Gilbert and G.R.Screaton.
Phys. Rev., Vol. 104, No. 6, 1758-9 (Dec. 15, 1956).

The Yang phase-shifts for meson–nucleon scattering are shown to be inconsistent with the general dispersion relations that are consequences of microcausality. A.

530.145

1916. GENERALIZED PHASE-SHIFT ANALYSIS AS A CONSEQUENCE OF THE UNITARITY OF THE S-MATRIX. Yu.A.Gol'fand.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 224-31 (1956). In Russian.

A method of determining the general form of the scattering amplitude is given by generalizing the usual formula of phase-shift analysis. A technique of invariant operators is developed which simplifies the calculation. It is related to an expansion in eigenfunctions of the total angular momentum. G.E.Brown

530.145

1917. TRANSFORMATION PROPERTIES OF THE ELECTRON–POSITRON FIELD.AMPLITUDES. Yu.A.Gol'fand.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 535-6 (1956). In Russian.

Behaviour of the amplitudes under Lorentz transformations, including spatial reflection, is studied. G.E.Brown

530.145

1918. THEORY OF COLLISIONS BETWEEN ELECTRONS AND ATOMS. G.F.Drukarev.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 288-301 (1956). In Russian.

A collision between an electron and an arbitrary atom is considered. The wave function of the atom + electron system with a prescribed spin is expressed in terms of the coordinate and spin functions of the system. The coordinate function of the system is constructed from the atomic and one-electron functions in such a way that it explicitly possesses the correct symmetry properties with respect to transposition of the arguments. A system of integro-differential equations similar to the Fok self-consistent field equations has been obtained for one-electron coordinate functions; the equations can be transformed into integral equations. The angular variables have been separated and integral equations for the radial one-electron functions have been obtained. The integral equations can be simplified if approximate atomic functions are used. The problem can be reduced to a system of Volterra integral equations and a system of algebraic equations which are convenient for general investigations as well as for computations. An analysis of the asymptotic expressions is carried out and formulae for effective cross-sections are derived. A.

530.145

1919. ILLUSTRATION OF THE THEORY OF THE DOUBLE SOLUTION BY AN EXAMPLE OF THE FORM OF THE SINGULAR WAVE-FUNCTIONS. L.de Broglie.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 617-20 (Aug. 13, 1956). In French.

The addition to the Klein–Gordon equation of a nonlinear source term leads to wave-functions with some of the properties postulated in the double-solution interpretation of wave mechanics. J.S.Bell

530.145

1920. THE SIGNIFICANCE OF $|\Psi|^2$ FOR STATIONARY STATES IN THE CAUSAL INTERPRETATION OF WAVE MECHANICS. L.de Broglie.
C.R. Acad. Sci. (Paris), Vol. 243, No. 8, 689-92 (Aug. 20, 1956). In French.

530.145

1921. PROPERTIES OF SOME QUANTUM-MECHANICAL QUANTITIES IN THE (CLASSICAL) LIMIT. V.P.Maslov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 623-6 (1954). In Russian.

This is a mathematical paper concerning differential equations of the type used in quantum mechanics. A limiting process is considered such that the term carrying the highest differential coefficient tends to zero. Reversion points in the WKB approximation present special instances of this limit. A number of relevant theorems are formulated but no proofs are given. R.Eisenschitz

530.145

1922. "SCHRÖDINGER FORM" OF RELATIVISTICALLY INVARIANT EQUATIONS. Yu.A.Yappa.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 817-20 (1954). In Russian.

The relativistically invariant-wave equation for a single particle can be put into a "Schrödinger form" i.e. a form in which the time dependence is included in the wave-function itself rather than the linear operators. This has the simplifying advantage that canonical transformations can be formally carried through as for a non-relativistic equation. Extension of the method to a system of many-particle equations is briefly discussed. J.W.Gardner

530.145

1923. ON A NEW CLASS OF RELATIVISTIC EQUATIONS FOR AN ELEMENTARY PARTICLE. Yu.M.Shirokov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 857-9 (1954). In Russian.

The reformulation of the relativistic equations proposed by Yappa (see preceding abstract) is extended to include angular momentum quantization explicitly. J.W.Gardner

530.145

1924. VACUUM EXPECTATION VALUES AS SUMS OVER HISTORIES. P.W.Higgs.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1262-73 (Dec., 1956).

The way in which vacuum expectation values may be calculated as sums over histories, according to Feynman's formulation of quantum mechanics, is discussed. It is shown that the evaluation of the functional integrals for the matrix elements of chronologically ordered operator products does not automatically lead to the propagators of quantized fields, as seemed to be so in a paper by Matthews and Salam; their work is criticized for its vagueness about boundary conditions. A limiting procedure for obtaining vacuum expectation values is defined: it involves the device of introducing an infinitesimal imaginary term into the Lagrangian and letting the epoch in which the matrix element is specified tend to infinity. It is demonstrated that the device commonly used in field theory for defining Feynman Green's function is of this type, but that it does not necessarily lead to vacuum expectation values when the Lagrangian is not quadratic. An alternative trick which is more generally applicable is suggested: this involves the use of a complex time parameter, which selects out the ground state in the limit of infinite epoch in a manner similar to the freezing into the ground state which occurs in thermal equilibrium at the absolute zero of temperature. A.

530.145

1925. FUNCTION SPACES IN QUANTUM-MECHANICAL THEORY. E.L.Hill.
Phys. Rev., Vol. 104, No. 4, 1173-8 (Nov. 15, 1956).

The use of wave-functions which are not normalized in the sense of quadratic integrability introduces concepts which are difficult to incorporate into the statistical interpertation of quantum-mechanical theory. A study i made of other inner-product function spaces which can be defined on the basis of the asymptotic behaviour of various classes of functions. Only the cases of plane waves, cylindrical waves, and spherical waves are considered in detail. The theory offers an alternative approach to the treatment of open systems which is closer to classical field theories than is that of von Neumann. A.

530.145

1926. EXACT QUANTUM DYNAMICAL SOLUTIONS FOR OSCILLATOR-LIKE SYSTEMS. M.Kolsrud.
Phys. Rev., Vol. 104, No. 4, 1186-9 (Nov. 15, 1956).

The solution of the quantum dynamical equation $ihdT/dt = HT$, for the time-displacement operator T, is given, when the Hamiltonian H is a polynomial of the second degree in canonically conjugate variables, with arbitrary time-dependent coefficients. Heisenberg's equations of motion are then solved, and the general integral of Schrödinger's equation in coordinate space is expressed by the Green's function corresponding to T. An example is given. A.

530.145

1927. NONRELATIVISTIC LIMIT OF A BETHE–SALPETER EQUATION. G.Wanders.
Phys. Rev., Vol. 104, No. 6, 1782-3 (Dec. 15, 1956).

A two-parameter integral representation for the Bethe–Salpeter amplitude describing a bound state of two scalar particles bound together by scalar mesons is defined. The "ladder approximation" of the Bethe–Salpeter equation is equivalent to an integral equation for the weight function of this representation. In the nonrelativistic limit of infinitely heavy bound particles and zero binding energy, a set of eigenvalues of this equation becomes identical with the spectrum of the corresponding Schrödinger equation with a Yukawa potential. A.

530.145

1928. NORMALIZATION OF BETHE–SALPETER WAVE FUNCTIONS. G.R.Allcock.
Phys. Rev., Vol. 104, No. 6, 1799 (Dec. 15, 1956).

The scalar product between any two bound states is expressed covariantly in terms of the Bethe–Salpeter component of the one, and the adjoint Bethe–Salpeter component of the other. A.

530.145

1929. EXPANSIONS FOR COULOMB WAVE-FUNCTIONS FOR HIGH ENERGIES. D.Geissler.
Z. Naturforsch., Vol. 11a, No. 7, 598-604 (July, 1956). In German.

Expansions in powers of $\eta = ZZ'e^2/\hbar v$ are given which are valid for small $\rho = kr$ and for large ρ. W.A.Hepner

530.145

1930. LAGRANGIAN FOR A SYSTEM OF IDENTICAL CHARGED PARTICLES. V.N.Golubenkov and Ya.A.Smorodinskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No.2(8), 330 (1956). In Russian.

In the interaction of particles, all of which have the same charge-to-mass ratio, radiation enters first in fifth order in v/c and a Lagrangian valid to fourth order can be written down. G.E.Brown

530.162

1931. RANDOM INTEGRALS OF THE DIFFUSION EQUATION. J.Kampé de Fériet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 14, 929-32 (Oct. 1, 1956). In French.

The solution of the one-dimensional diffusion equation for given initial conditions in a medium of constant velocity (U) depends parametrically on U. If U is a random variable, then the solution becomes a random function of (x,t) some of whose properties are studied here. R.O.Davies

530.162

1932. EQUATIONS WITH VARIATIONAL DERIVATIVES AND DISTRIBUTION FUNCTIONS FOR SYSTEMS WITH COMPLEX INTERACTIONS. I.P.Bazarov.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 1, 38-41 (1956). In Russian.

Functional equations similar to those for an ideal gas, but containing the external field as an operator, are found. A method of successive approximation for finding the distribution function is outlined. G.E.Brown

530.162

1933. BOLTZMANN EQUATION FROM THE STATISTICAL MECHANICAL POINT OF VIEW. M.S.Green.
J. chem. Phys., Vol. 25, No. 5, 836-55 (Nov., 1956).

The Boltzmann equation for a spacially uniform situation is derived by the method of expansion of the molecular distribution functions in powers of the concentration. These expansions are shown to imply that after a time which depends on the initial phase space distribution and for configurations in which the molecules are not too widely separated, all the distribution functions are functionals of the single-particle distribution. The single-particle distribution obeys an equation which is a generalization of the Boltzmann equation which includes the effects of triple and higher collisions. The triple collision term is given explicitly. A.

530.162

1934. A NEW UNCERTAINTY RELATION. H.T.Flint and E.M.Williamson.
Nature (London), Vol. 178, 651 (Sept. 22, 1956).

On the basis of 5-dimensional theories the additional relation $\Delta m_0.\Delta\tau \sim \hbar/c^2$ is proposed, m_0 being the rest-mass and τ the proper time. This relation is to be regarded as quite distinct from the energy relation $\Delta E.\Delta t \sim \hbar$. R.A.Newing

530.162

1935. STATISTICAL MECHANICS OF TRANSPORT PROCESSES: INTERNATIONAL COLLOQUIUM. R.Eisenschitz.
Nature (London), Vol. 178, 899-900 (Oct. 27, 1956).

Short report on an international conference, concerned with the statistical theory of transport processes and the thermodynamics of non-equilibrium states, organized by the International Union of Pure and Applied Physics (Brussels, August 27-31, 1956). R.Eisenschitz

530.181

1936. LINEAR SYSTEMS. B.Gross.
Nuovo Cimento Suppl. (Ser. 10), Vol. 3, No. 2, 235-96 (1956). In German.

There are three main sections devoted respectively fundamentals, spectra and reactance systems. In the first part the application of contour integration to network theory is described and the question of realizability is discussed. In the second part mathematical operations on spectra are dealt with and some space is devoted to the concept of the delta-function. In the last section the distribution of poles is investigated for a variety of practical systems. S.C.Dunn

530.19 : 523.85

1937. PHYSICAL CONSTANTS IN EXTRA-GALACTIC NEBULAE. M.P.Savedoff.
Nature (London), Vol. 178, 688-9 (Sept. 29, 1956).

Recent wavelength measurements (Minkowski and Wilson, 1956) of lines H, N II, O I, O II, Ne III and Ne V for the colliding galaxies identified with the radio-source Cygnus A, when combined with the radio measurements for this source (see Abstr. 5622/1956) enable estimates to be made of the ratio of galactic to local values of functions involving both the fine-structure constant, α, and the proton gyromagnetic ratio, g. For the first of these, the ratio is 1.0036 ± 0.0032, and for the second 0.9967 ± 0.0032. Taking into account the precision of current measurements, these results imply a constancy of the above physical constants for two galaxies separated by 3×10^8 light-years. D.R.Barber

GENERAL MECHANICS. MECHANICS OF SOLIDS 531

531.577/.578

1938. SPATIAL DISTRIBUTION OF FRAGMENTS OF EXPLOSIVELY LOADED THIN-WALLED STEEL CYLINDERS. S.Singh.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1089-94 (Nov., 1956).

This paper describes the spatial distribution of fragments on static detonation of a thin-walled steel cylinder internally loaded with explosives. The fragments on striking a mild steel "witness-plate" produce a fragmentation pattern and a simple analysis of its geometry indicates the direction of emission of the fragments. Experimental results indicate that the direction of emission of most of the fragments make an angle of 7.5^0 to the normal to the inner surface of the cylinder and away from the exploder. A.

MECHANICAL MEASUREMENTS 531.7

531.711

1939. ACCURATE LINEAR SCALES RULED ON A GRATING ENGINE. D.Richardson and R.M.Stark.
J. Opt. Soc. Amer., Vol. 47, No. 1, 1-5 (Jan., 1957).

The absolute spacing ruled by a grating engine is determined by ruling a linear scale and using it as a diffraction grating. The angles of incidence and diffraction are measured with a spectrometer. After the wavelengths are adjusted to the experimental conditions, the average spacing of the scale is calculated from the grating equation. Wavelength standards are thus used directly for determining line standards of length. A procedure is described for calculating the engine setting to rule a scale with a desired spacing. A 3 in. scale ruled according to this procedure has been certified by the National Bureau of Standards, the certification agreeing with the calculated value for its length to within 10 microinches. A.

531.715.2 : 535.8

1940. MEASUREMENT OF SMALL DISPLACEMENTS OF A PLANE SURFACE WITH A SEMI-VIRTUAL SLIT MODULATOR. P.Barret.
J. Phys. Radium, Vol. 17, No. 6, 29 S (June, 1956). In French.

This method is suitable for measuring the displacement of a polished or plated surface. A metal plate, such as a razor blade, is mounted parallel to and about 0.01 mm away from the surface. Observation of the slit at grazing incidence shows a real and a virtual (reflected) edge. Variations in the magnitude of this "semi-virtual slit" are used to modulate a beam of light falling on a photocell for recording static or dynamic displacements of the surface. H.J.H.Starks

MECHANICS OF FLUIDS 532

532.13 : 532.773 : 541.64

1941. VISCOSITY OF POLYMERS IN CONCENTRATED SOLUTIONS. F.Bueche.
J. chem. Phys., Vol. 25, No. 3, 599-600 (Sept., 1956).

Previous theories predict $\eta \propto M^{2.5}$ for large molecular weights (M), whereas $\eta \propto M^{3.4}$ is found experimentally. The discrepancy is due to the neglect of a circulation effect within each molecule; when this is included in the theory it gives $\eta \propto M^{3.5}$. G.Allen

532.13.08

1942. DYNAMIC DETERMINATION OF VISCOSITY. A.Carrelli and A.De Vito.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 1009-16 (Nov., 1956).

A method is described for measurement of the coefficient of internal friction in fluids, in such conditions that the velocity of the various layers and the velocity gradient are not constant in time. The experimental results show that the fluids having a complex molecular structure exhibit in such dynamical conditions of measurement values of the coefficient of internal friction which differ from the ones obtained in the conditions in which the velocities and the velocity gradient are constant. A.

532.517.2

1943. CONCERNING LAMINAR FLOW IN CHANNELS WITH POROUS WALLS. A.S.Berman.
J. appl. Phys., Vol. 27, No. 12, 1557-8 (Dec., 1956).

It is considered that Yuan's solution (Abstr. 6409/1956) is doubtful, as regards validity, for large suction Reynolds numbers; the highest derivative term cannot be neglected for large suction in the neighbourhood of the wall. J.S.G.Thomas

532.517.4 : 541.133.08

1944. TURBULENT CONCENTRATION FLUCTUATIONS THROUGH ELECTRICAL CONDUCTIVITY MEASUREMENTS. J.M.Prausnitz and R.H.Wilhelm.
Rev. sci. Instrum., Vol. 27, No. 11, 940-3 (Nov., 1956).

A description is given of an instrument for measuring turbulent concentration fluctuations in the liquid phase. A calibrated conductivity cell is used to measure the conductivity of a small volume surrounding a fixed point in a turbulent fluid. The output of the cell is fed into suitable electronic apparatus. Mean-square and mean-absolute concentration fluctuations are measured. The method gives promise of providing a new experimental technique for the study of turbulence. Measurements permit calculation of a scale of turbulence with a standard deviation of $\pm 2.8\%$. A.

532.52

1945. TRANSPORT PROPERTIES OF A DENSE FLUID OF HARD SPHERES. H.C.Longuet-Higgins and J.A.Pople.
J. chem. Phys., Vol. 25, No. 5, 884-9 (Nov., 1956).

From the two assumptions, that the pair distribution function of relative position is independent of the rate of strain or the temperature gradient and that the velocity distribution is locally Maxwellian, expressions are derived for the shear viscosity η, the bulk viscosity κ and the thermal conductivity λ of a hard-sphere fluid at high densities. An expression is also derived for the coefficient of self-diffusion D at any density by assuming that the autocorrelation function for the velocity of a given particle decays exponentially. A.

532.59

1946. MOTION OF A COMPRESSION WAVE IN A FLUID CONTAINED WITHIN A RIGID TOROID OF SQUARE SECTION. G.Karpman.
C.R. Acad. Sci. (Paris), Vol. 243, No. 10, 770-3 (Sept. 3, 1956). In French.

The propagation of a stationary compression wave is discussed mathematically. It is shown that potential and kinetic energies in the wave motion are of the same order of magnitude. The group of energies corresponding to the stationary waves constitute a definite set, the individual levels of which are not necessarily stable with respect to external perturbations. J.S.G.Thomas

CAPILLARITY 532.6

532.612.4 : 536.48

1947. THE SURFACE TENSION OF LIQUID He^3 IN THE REGION OF VERY LOW TEMPERATURES (1.0 - 0.35°K). K.N.Zinov'eva.
Zh. éksper. teor. Fiz., Vol. 29, No. 6(12), 899-901 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 4, 774-5 (July, 1956).

Measurements by capillary rise have been extended with data now existing from the critical temperature to 0.35°K. Below 0.6°K a limiting value of 0.152 dyne cm^{-1} is approached which is much smaller than the limiting value for He^4. The character of the temperature dependence in He^4 and He^3 is the same, as shown by a plot of the ratio of the surface tension to its limiting value as a function of T/T_{cr}.
F.E.Hoare

532.62

1948. SURFACE TENSION AS THE CAUSE OF BÉNARD CELLS AND SURFACE DEFORMATION IN A LIQUID FILM. M.J.Block.
Nature (London), Vol. 178, 650-1 (Sept. 22, 1956).

Bénard observed cellular deformations on the free surface of thin liquid films when a temperature gradient existed between the two surfaces, an effect which Rayleigh attributed to convective instability. The author has carried out a number of experiments which show that this cannot be the case and that the effect is one of surface tension. For example a silicone monolayer immediately disperses the deformation and further the cells have been produced under conditions where there can be no corrective instability. T.C.Toye

532.65

1949. APPARATUS FOR THE PRODUCTION OF LARGE WATER DROPS. R.H.Magarvey and B.W.Taylor.
Rev. sci. Instrum., Vol. 27, No. 11, 944-7 (Nov., 1956).

Drop generators are described for the production of streams of drops the equivalent diameters of which are between 0.5 and 20 mm. These generators are based on the principle of the interrupted jet described by Lord Rayleigh. An assessment is made of the advantages and disadvantages of drop production based on this principle, and data given showing a high degree of uniformity of drop size. Accurate size control and determination are discussed relative to the execution of experiments designed to measure the physical properties of drops during free fall. In order to study the instability and breakup of large drops, reasonably well-formed drops are produced with equivalent diameters that are extremely difficult to produce by any other method. The behaviour of large drops during free fall is concerned with theories of drop size distribution in natural rain.
A.

532.65

1950. CONTRIBUTION TO THE PROBLEM OF THE EXISTENCE OF A TRANSITION LAYER ON THE SURFACE OF A LIQUID. V.A.Kizel' and A.F.Stepanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 527-8 (1956). In Russian.

A beam of light, incident at nearly Brewster's angle of polarization, is reflected from the surface of transparent liquids. The ellipticity of the reflected light is measured as a function of the wavelength. Also the phase difference between the incident and the reflected beam is measured as a function of the angle of incidence. Results are checked against theoretical formulae. It is claimed that the agreement between experiment and theory is sufficient for establishing the existence of a transition layer beyond doubt.
R.Eisenschitz

MOLECULAR THEORY OF LIQUIDS 532.7

532.7

1951. VELOCITY OF SOUND AND ZERO-POINT ENERGY FOR THE QUASI-CRYSTAL LATTICE OF LIQUIDS. V.V.Tarasov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1125-8 (1954). In Russian.

In specifying properties of the liquid state the author employs a lattice model in combination with empirical relations. He shows in which way a certain parameter has to be adjusted in order to conform with the dependence upon the temperature of the velocity of sound in liquid oxygen and liquid nitrogen. R.Eisenschitz

532.7 : 534.22

1952. CALCULATION OF THE FREE VOLUME AND THE INTERNAL PRESSURE OF LIQUIDS FROM SONIC VELOCITY DATA. F.C.Collins, W.W.Brandt and M.H.Navidi.
J. chem. Phys., Vol. 25, No. 3, 581 (Sept., 1956).

Better values than those obtained previously (Abstr. 8958/1954) can be obtained by first obtaining an expression for Pi, the internal pressure, from the thermodynamic equation of state and the Rayleigh equation. Using values of Pi thus calculated, in the free volume equation of state yields values for v_o/v and hence values for v_f can be obtained. Though there is dependence upon assumptions regarding the geometry of the free volume, results agree well with those of the previous paper. T.C.Toye

532.7 : 536.71

1953. EQUATION OF STATE OF WATER ON THE THOMAS–FERMI MODEL. A.Latter and R.Latter.
J. chem. Phys., Vol. 25, No. 5, 1016-23 (Nov., 1956).

Two methods are described for extending the Thomas–Fermi model of a compressed atom to molecules containing two types of atoms. The methods are applied to H_2O at zero temperature to determine pressure and internal energy as functions of the density, the position of the protons relative to the oxygen nucleus, and the electrostatic potential distribution within the molecule. A.

532.7 : 539.152.2

1954. NUCLEAR MAGNETIC SPIN-LATTICE RELAXATION IN LIQUIDS. H.S.Gutowsky and D.E.Woessner.
Phys. Rev., Vol. 104, No. 3, 843-4 (Nov. 1, 1956).

Measurements were made of T_1 in n.m.r. for both H and F in CH_2FCl, $CHFCl_2$, CHF_2Cl and 1:3:5-trifluorbenzene. The fluorine relaxation times are 1.5 to 10 times smaller than the hydrogen ones and decrease with field strength. Anisotropy of the chemical shift tensor produces magnetic field fluctuations consequent on molecular orientation which are field dependent. The observed anisotropy for the trifluorbenzene is 7.5×10^{-4} which is about 3/2 times the shift, 6.5×10^{-4} which is expected if the shift is primarily due to 2nd order paramagnetism of the covalent p electron. D.H.Whiffen

532.7

1955. ELECTRON SCATTERING ON THERMAL OSCILLATIONS IN A LIQUID. A.I.Gubanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 462-72 (1956). In Russian.

It is shown that if rigorous periodicity is absent in a liquid conductor the law of conservation of momentum in the electron–phonon system may not necessarily hold for electrons scattered on thermal oscillations. Thus besides the usual type of scattering of electrons on phonons in liquids an additional phonon–liquid scattering exists. The electron mean free path corresponding to this scattering in liquid metals and semiconductors has been computed. A.

532.71

1956. A STATISTICAL THEORY OF OSMOTIC EFFECTS. G.Petit.
C.R. Acad. Sci. (Paris), Vol. 243, No. 5, 485-7 (July 30, 1956). In French.

An attempt to base the theory of osmotic effects on the following assumption: when solute molecules are added to a solvent (which is separated from pure solvent by a barrier impermeable to the solute) the fractional change in the probability of transition of solvent molecules through the barrier is the same on either side. R.O.Davies

532.72

1957. A SOLUTION OF THE DIFFUSION EQUATION FOR ISOTOPIC EXCHANGE BETWEEN A SEMI-INFINITE SOLID AND A WELL STIRRED SOLUTION. I.R.Beattie and D.R.Davies.
Phil. Mag. (Eighth Ser.), Vol. 1, 874-9 (Sept., 1956).

A theoretical solution of the problem of diffusion of material from a semi-infinite solid of known surface area into a given volume of a well-stirred liquid is derived. The equations developed are based on the assumption that Fick's law may be applied to the system under consideration. A.

532.74 : 539.172.13

1958. CROSS-SECTION OF THE METHYL MERCAPTAN MOLECULE FOR THE SCATTERING OF SLOW NEUTRONS. W.Kołos.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 5, 269-71 (1956).

A calculation carried out to decide, with the help of future experiments, whether the proton cross-section is influenced by association of the molecules in the liquid state. J.Thewlis

532.77

1959. MODEL FOR METAL AMMONIA SOLUTIONS. E.Becker, R.H.Lindquist and B.J.Alder. J. chem. Phys., Vol. 25, No. 5, 971-5 (Nov., 1956).

A model is proposed for dilute metal ammonia solutions in which the neutral species is a metal ion solvated by ammonia molecules, with the valence electron from the metal ion localized on the protons of these ammonia molecules. This species can dissociate in a manner similar to an ion pair, and the equilibrium constant for this dissociation as estimated agrees with the one derived from electrical conductivity data. Also, two neutral species can associate to form a dimer species, and the calculated energy of formation of this dimer is in satisfactory agreement with the binding energy derived from magnetic susceptibility data. This model is consistent with the large volume increase on mixing and with some aspects of the absorption spectrum. A.

532.77 : 536.71

1960. ON THE CORRELATION BETWEEN THE THERMODYNAMIC EXCESS FUNCTIONS AND THE VIRIAL COEFFICIENTS OF MACROMOLECULAR SOLUTIONS. G.V.Schulz and H.J.Cantow. Z. Elektrochem., Vol. 60, No. 5, 517-21 (1956). In German.

According to Reik and Gebert (Abstr. 2477/1955) the excess free energy ($\Delta\mu^E$), enthalpy (Δh^E), and entropy (Δs^E) of dilution are quadratic functions of the concentration (c) for dilute polymer solutions when the osmotic pressure can be represented by a virial expansion broken off at the term in c^2. The present paper shows that this is not necessarily true. Even though the higher virial coefficients may vanish their temperature coefficients can still have finite values, and consequently the equations for Δh^E and Δs^E will include terms in c^3 etc. A temperature, at which Van't Hoff's law is obeyed, can be defined for the solution. This represents only a pseudo-ideal state since the excess functions do not necessarily vanish. The system will be ideal only if Van't Hoff's law is obeyed over a range of temperature. The minimum number of measurements required for the calculation of the thermodynamic functions of the system is also discussed. G.Allen

MECHANICS OF GASES 533

533.5 : 531.788.7

1961. STUDY OF THE USE OF THERMISTORS FOR THE MEASUREMENT OF LOW PRESSURES. M.Varičak. C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 893-5 (Sept. 24, 1956). In French.

The increase in sensitivity of a low-pressure gauge using a thermistor bead (resistivity 120 000 ohm cm at 20° C and resistance temperature coefficient −0.0412 per °C), produced by lowering the wall temperature and by increasing the heat dissipating surface of the thermistor, was tested. Pressures down to 10^{-6} mm of mercury could then be measured. S.Weintroub

533.5 : 531.788.7

1962. THE MEASUREMENT OF VERY LOW GAS AND VAPOUR PRESSURES. F. Kirchner and H.Kirchner. Z. angew. Phys., Vol. 8, No. 10, 478-81 (Oct., 1956). In German.

The time rate of variation of the electron emission from a freshly heated tungsten point in a discharge tube shut off from the diffusion pump by a heated high-vacuum valve and at pressures $< 10^{-7}$ mm Hg was compared with the readings of an Alpert ionization gauge. The emission varied because of the formation of an adsorption layer covering the tungsten surface. The time for covering the surface with a less than monatomic layer was much greater than one would expect from the number of molecular collisions, in accordance with kinetic theory, corresponding to the gauge pressure, both for air as residual gas and in accordance with former experiments on the adsorption of a monatomic oxygen layer. Since the covering times were considerably shorter when the gauge was connected than when disconnected, it is presumed that the residual gas was not air but a heavily volatile substance which produces conditions similar to that of an oxygen layer. It was shown that the gauge acts as an "ion pump". With a positive field of 6×10^7 V/cm applied to the tungsten point the number of collisions of the residual gas molecules, deduced from the time taken to form a given covering layer, was about double that for zero field and it is calculated that this is in conformity with a value of approximately 4×10^{-24} c.g.s. e.s.u. for the electrical polarizability per residual gas molecule. S.Weintroub

533.5

1963. SOME PECULIARITIES OF DYNAMIC VACUUM SYSTEMS. A.L.Mints and N.M.Kristi. Zh. tekh. Fiz., Vol. 26, No. 8, 1815-22 (1956). In Russian.

The possibility is demonstrated of applying devices with deep slit-shaped cavities ("pockets") in vacuum systems which serve for establishing and maintaining a low gas pressure in the pumped volume by means of continuously-operating pumps. A description is given of a method of transmitting large powers by means of a rotating shaft which passes through a narrow gasketless channel from the cavity with preliminary vacuum into the high-vacuum space. F.Lachman

533.59

1964. HIGH-VACUUM GAS VALVE. R.G.Nester. Rev. sci. Instrum., Vol. 27, No. 10, 874-5 (Oct., 1956).

The action of the valve depends on the differential thermal expansion of a short length of glass capillary tube and its gold filling. A heater wire round the tube provides the control. K.W.Plessner

533.59

1965. LIQUID NITROGEN VACUUM TRAP CONTAINING A CONSTANT COLD ZONE. J.E.Kunzler. Rev. sci. Instrum., Vol. 27, No. 10, 879 (Oct., 1956).

The cooled condensation cylinder is constructed of 1/16 in. copper and is in contact with the liquid nitrogen container only over the bottom inch. The level of coolant therefore does not affect the temperature of the condensing surface provided there is at least 1 in. of liquid nitrogen left. K.W.Plessner

533.6.011

1966. ONE-DIMENSIONAL INVISCID FLOW THROUGH A ROCKET NOZZLE. R.P.Rastogi and T.P.Pandya. J. chem. Phys., Vol. 25, No. 5, 1009-12 (Nov., 1956).

A thermodynamic theory of one-dimensional nonisentropic flow through a rocket nozzle is developed by using a parameter called "extent of reaction" introduced by de Donder. The formalism makes it possible to compute the exhaust velocity and cooling rate when there are significant departures from chemical as well as internal equilibrium. It is shown that the cooling rate at the throat is likely to increase when the departures from equilibrium become significant. A.

533.6.011

1967. ISENTROPIC RELATIVISTIC GAS FLOW. F.I.Frankl'. Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 490-2 (1956). In Russian.

General baroclinic isentropic relativistic gas flows are considered. The vortex equations and the nonlinear equation of propagation of sound are derived. A relativistic generalization of Thomson's theorem is derived for the case of barotropic flow. A.

533.6.07

1968. CONTROLLED CAPILLARY GAS LEAK. R.K.Smither. Rev. sci. Instrum., Vol. 27, No. 11, 964-5 (Nov., 1956).

A relatively simple adjustable leak is described in which the gas flow is controlled by regulating the temperature of the gas in the capillary. This capillary leak contains no moving parts and can be controlled from a distance. The actual controlled flow is compared with the theoretical predictions, and a calibration curve is shown. A.

MOLECULAR THEORY OF GASES 533.7

533.7

1969. MASS SPECTROMETRIC STUDY OF COPPER, SILVER AND GOLD. J.Drowart and R.E.Honig. J. chem. Phys., Vol. 25, No. 3, 581-2 (Sept., 1956).

Measurements on vaporization of solids revealed small concentrations of diatomic molecules in addition to atomic species. Estimates of dissociation energy of molecular Cu_2, Ag_2, and Au_2 based on the measurements and several assumptions agree well with values obtained otherwise. C.G.Morgan

533.7

1970. MOLECULAR COMPOSITION OF ALKALI HALIDE VAPORS. R.C.Miller and P.Kusch.
J. chem. Phys., Vol. 25, No. 5, 860-76 (Nov., 1956).

An analysis of the velocity distribution of the molecules which escape through an ideal aperture from an isothermal enclosure has been made for ten alkali halides (CsCl, CsBr, RbCl, KCl, KCl, KI, NaF, NaCl, NaI, LiCl, and LiBr). It is found that there is a significant abundance of dimers in all cases except those of the caesium salts, and that an observable concentration of trimers occurs for NaF, LiCl and LiBr. Observation of the relative abundances of the polymers as the temperature of the effusing gas and the pressure within the source is varied permits the determination of the energy of dissociation of the dimer into two monomers and of the trimer into a monomer and dimer. A.

533.7

1971. A METHOD OF OBTAINING NON-STATIONARY SOLUTIONS OF BOLTZMANN'S KINETIC EQUATION. I.I.Moiseev-Ol'khovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 2 (8), 238-43 (1956). In Russian.

A method is considered which permits one to obtain non-stationary solutions of Boltzmann's kinetic equation and which is free of the restraints imposed by the Chapman–Enskog method. As an illustration dispersion of plane sound waves travelling in monoatomic gases is examined. A.

533.73

1972. ANALYTICAL STUDIES RELATED TO THE MAXWELL–BOLTZMANN EQUATION. D.Morgenstern.
J. rational Mech. Anal., Vol. 4, 533-55 (1955).

An integrodifferential equation is studied. This is obtained by a modification of the Maxwell–Boltzmann equation of the kinetic theory of gases, and is more amenable to mathematical treatment. Some theorems on existence and uniqueness are proved, and a proof is also given of the trend towards equilibrium in the spatially homogeneous case. Mathematical Reviews

VIBRATIONS. ACOUSTICS 534

534.01 : 621.37

1973. EVEN-ORDER SUBHARMONIC OSCILLATIONS. W.J.Cunningham.
J. appl. Phys., Vol. 27, No. 11, 1374-5 (Nov., 1956).

The generation of an even-order subharmonic, or harmonic, oscillation in a driven nonlinear resonant system described by just a cubic nonlinear term requires the simultaneous appearance of a zero-frequency component. This component effectively introduces a squared nonlinear term. A simple experiment with an electrical circuit is described, showing the presence of the zero-frequency component. A.

534.113

1974. THE FREQUENCY OF VIBRATION AND THE ELASTIC STABILITY OF A FIXED-FREE STRIP. R.F.S.Hearmon.
Brit. J. appl. Phys., Vol. 7, No. 11, 405-10 (Nov., 1956).

The suggestion that critical buckling loads can be found by estimating the load at which the frequency of vibration becomes zero is subjected to experimental test on fixed-free strips of boxwood, brass and steel. The results show good agreement between the load at zero frequency and the critical load calculated from the Euler formula. A.

534.131

1975. THE HORIZONTAL PERIODIC FORCES ACTING ON A TOWER BY RINGING OF BELLS. W.Kallenbach.
Z. angew. Phys., Vol. 8, No. 10, 508-12 (Oct., 1956). In German.

In a theoretical treatment, the tower is assumed to be a simple pendulum; curves are derived showing the magnitude and phase relationships of the horizontal forces at the top of the tower for different bell oscillations. From these the fundamental and third harmonic vibrations are deduced and it is shown that, when the bell oscillations are large, the magnitude of the third harmonic exceeds that of the fundamental vibration. H.J.H.Starks

534.21

1976. CONDITIONS FOR OBTAINING MAXIMUM ULTRASOUND CONCENTRATION. L.D.Rozenberg.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 845-8 (1954). In Russian.

Theoretical paper. The author calculates the amplitude distribution function over the wavefront for maximum values of acoustic pressure and vibrational velocity. The value of the sound pressure for the optimum distribution function is worked out. Curves are given for the variation, with angular aperture of the wavefront, of the pressure and velocity focusing factors. C.R.S.Manders

534.22 : 532.7

1977. MEASUREMENTS OF THE VELOCITY AND ABSORPTION OF HIGH-FREQUENCY ULTRASONIC WAVES IN SUPERCOOLED LIQUIDS. A.N.Hunter.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 965-74 (Oct., 1956).

Measurements of ultrasonic velocity and absorption have been made in five polar liquids, including the supercooled region. Discontinuities occur in the gradient of the velocity–temperature relation similar to those observed by others in the case of viscosity and dielectric constant. The absorption rises steeply below the melting point and minima occur above the melting. Simple theories based on a suspension of "crystallites" are shown to be inadequate. The fall in the ratio of observed to shear viscosity absorption in the supercooled region is suggestive of association. A.

534.23 : 539.132

1978. ULTRASONIC STUDIES OF SATURATED HYDROCARBONS AT LOW TEMPERATURES. J.M.Young and A.A.Petrauskas.
J. chem. Phys., Vol. 25, No. 5, 943-8 (Nov., 1956).

Ultrasonic propagation properties of 2-methylbutane, 3-methylpentane, n-pentane, 2,3-dimethylbutane, and 2,2-dimethylbutane were studied using a pulse method in the range from 1 Mc/s to 35 Mc/s and from 130° K to 280° K. These studies revealed the existence of an attenuation peak in 2-methylbutane, in 2,3-dimethylbutane, and in 3-methylpentane. These peaks were found to be consistent with a single relaxation process. Activation energies for the relaxation process in 2-methylbutane and 3-methylpentane were found to be about 4.7 kcal/M, and about 3.3 kcal/M in 2,3-dimethylbutane. No absorption was observed in n-pentane and 2,2-dimethylbutane. In a mixture of 3-methylpentane and n-pentane, measurements at 5 Mc/s showed an absorption peak at the same temperature as in 3-methylpentane, reduced in amplitude in proportion to the reduction in the number of molecules of 3-methylpentane. These observations indicate that the mechanism of absorption is explainable in terms of a hindered rotation (about the middle C–C bond in butanes and about the 2nd and 3rd C–C bonds in 3-methylpentane), leading to potential minima of unequal values for the different rotational isomeric states. Such asymmetry in the different rotational isomers appears to be an essential requirement for ultrasonic absorption in these molecules. A.

534.23 : 535.11 : 536.33 : 538.56

1979. SELF-ABSORPTION OF A RADIATING SPHERE. Yu.P.Bulashevich.
Zh. tekh. Fiz., Vol. 26, No. 11, 2599-600 (1956). In Russian.

Simplified version of the treatment by Bak et al. (Abstr. 6455/1956).

534.23 : 535.11 : 536.33 : 538.56

1980. ON THE PAPER "RADIATION FROM A SPHERE IN THE PRESENCE OF SELF-ABSORPTION". V.N.Timofeev and A.S.Nevskiĭ; N.G.Gusev and E.E.Kovalev.
Zh. tekh. Fiz., Vol. 26, No. 11, 2600-1, 2602 (1956). In Russian.

It is pointed out that the formula obtained by Bak et al. (Abstr. 6455/1956) for the self-absorption of a radiating sphere has been published earlier (W.Nusselt, Forschungsarbeiten auf dem Gebiet des Ingenieurwesens, No. 264, 1923; W.R.Dixon, Abstr. 7247/1951).

534.23

1981. ULTRASONIC ABSORPTION THEORY OF GIERER AND WIRTZ. R.T.Beyer.
J. chem. Phys., Vol. 25, No. 2, 219-22 (Aug., 1956).

The absorption theory of Gierer and Wirtz (Abstr. 7809/1950, 146/1951) is applied to a calculation of the temperature coefficient of the ultrasonic absorption coefficient for a number of liquids, and the results are compared with known experimental values. Where meaningful values are obtained in the theory, the temperature coefficient is always negative, in contrast to the sometimes positive coefficients that have been determined experimentally. It is concluded that the theory is not generally applicable. A.

534.232 : 621.395.623.7

1982. THE BASS REFLEX ENCLOSURE IN ACOUSTICS. F.J.v.Leeuwen.
T. Ned. Radiogenoot., Vol. 21, No. 5, 195-235 (Sept., 1956). In Dutch.

An investigation of the behaviour of a bass-reflex enclosure. From the electrical impedance, measured at various frequencies at the terminals of the loudspeaker, the mechanical impedance encountered by the rear side of the loudspeaker cone is computed. The acoustic parameters of the enclosure can be deduced from this mechanical impedance. The parameters of the loudspeaker and the enclosure being known, the frequency response of the system is calculated, and agrees well with the measured response. It is now possible to design an enclosure with predicted properties for a given loudspeaker. Graphs are given for simplifying the work. A.

534.25

1983. NOTES ON THE MEASUREMENT OF THE ACOUSTIC BI-REFRINGENCE IN COHERENT LIGHT. J.Badoz.
J. Phys. Radium, Vol. 17, No. 7, 607-8 (July, 1956). In French.

A formula is derived which is very similar to that due to Peterlin (Abstr. 3000/1950) for intermittent light. T.C.Toye

534.61

1984. DETERMINATION OF NOISE INTENSITY FOR SOUND LEVELS VARYING WITH TIME. G.Bobbert and R.Martin.
VDI Z., Vol. 98, No. 19, 997-1002 (July 1, 1956). In German.

Formerly the mean noise intensity or loudness levels varying with time were estimated either from measurement of the momentary values or by a method due to H.Kösters (Akustische Zeitschrift, Vol. 3, 310, 1938) by planimetry of the sound-level record. A method is now described by which the mean sound level over a small range is automatically recorded. Records are shown of the variation of street noise in a 24 hour period, the microphone and counting equipment being fitted in a private car. From 6 a.m. to 10 p.m. the sound level is around 85 phons (D.I.N.), falling to 60 phons during the night period 1 to 5 a.m. On the same record is shown the variation in the traffic density (number of vehicles per 15 minutes) falling from 100 to 10 or less in the above-mentioned periods. A.B.Wood

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85.

534.851

1985. MECHANICAL PHENOMENA IN GRAMOPHONE PICK-UPS AT HIGH AUDIO FREQUENCIES. J.B.S.M.Kerstens.
Philips Tech. Rev., Vol. 18, No. 3, 89-97 (1956-57).

The mechanics of the system pick-up—gramophone record are considered. The stylus (sapphire, diamond) whose spherical tip rides in the groove of the record, causes elastic deformation of the groove walls. The convex wall is deformed to a greater depth than the concave wall. This causes a loss in the stylus deflection, the static tracing loss. A second effect — the dynamic tracing loss — has likewise the nature of a loss as long as the stiffness force of the pick-up exceeds the inertia force on the stylus tip; this is the case at frequencies below the free resonance frequency of the pick-up system. At higher frequencies this loss becomes negative and thus acts in opposition to the static loss. The total loss (the sum of the static and the dynamic losses) may even become negative. This is liable to happen particularly in the neighbourhood of the frequency at which resonance of the groove-wall stiffness and the effective mass at the stylus tip occurs; the resonance curve of this system is called the dynamic pick-up characteristic. A combination of the latter with the static characteristic produces the actual pick-up characteristic. According to whether the cut-off frequency lies higher or lower than the stylus-groove resonance frequency, the actual characteristic will either show a slight peak or no peak at all. A.

OPTICS. RADIATION. SPECTRA 535

535.11 : 536.33 : 538.56 : 534.23

SELF-ABSORPTION OF A RADIATING SPHERE. See Abstr. 1979-80

535.14 : 530.162

1986. APPLICATION OF THE THEORY OF RANDOM PROCESSES TO THE TRANSFER PHENOMENA OF RADIATION. L.M.Biberman and B.A.Veklenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 341-2 (1956). In Russian.

Radiation propagating in isotropic surroundings and interacting with matter is assumed to consist of photons which perform a random movement. Events such as scattering, absorption, re-emission are associated with probabilities governing the transition of a photon from some initial to some final state. Once these assumptions are laid down the propagation of radiation is specified as stochastic processes in terms of standard equations. In particular the distribution of photons is determined by integro-differential equations of a familiar type. It is claimed that this approach is in accordance with most of the established results regarding radiative transfer. R.Eisenschitz

535.237

1987. MODULATION OF RADIANT ENERGY FROM INCANDESCENT FILAMENTS. W.E.Tolles and L.C.Ihrig.
J. Opt. Soc. Amer., Vol. 47, No. 1, 101-2 (Jan., 1957).

The fluctuations in temperature of an a.c.-heated filament modulate the radiant energy produced. This paper considers the amplitude of the modulation as a function of temperature and wavelength of radiation. In a lamp heated with 60 c/s power the modulation amplitude may become rather large (10% or more) as the wavelength of radiation decreases toward the ultraviolet region. Therefore, when an a.c.-heated lamp is used in photometric scanning procedures it is necessary to consider the modulation if transmission measurements are made. Some measurements of modulation amplitude vs. wavelength are given for two types of 100 W tungsten-filament lamp heated with 60 c/s power. The ratio of the modulation amplitude over the complete spectrum to that at a specific wavelength is proportional to the product of temperature and specific wavelength; hence a method of measuring temperature of an a.c.-heated filament is obtained. A.

535.314

1988. REFRACTION OPERATORS AND RAY TRACING THROUGH CONES OF CONSTANT INDEX. F.D.Bennett.
J. Opt. Soc. Amer., Vol. 47, No. 1, 85-91 (Jan., 1957).

A dyadic representation for Snell's law of refraction is derived and its properties discussed. Alternate forms are given. The problem of ray tracing through a cone of constant refractive index is formally solved in terms of the refraction dyadic. The class of rays which only pierce the cone once is exhaustively discussed. A.

535.317.5

1989. OPTICAL ABERRATION COEFFICIENTS. I. THE COEFFICIENT OF TERTIARY SPHERICAL ABERRATION. H.A.Buchdahl.
J. Opt. Soc. Amer., Vol. 46, No. 11, 941-3 (Nov., 1956).

A computing scheme involving only 19 entries per surface is developed for the calculation ab initio of the coefficient of tertiary spherical aberration (and incidentally also the primary and secondary coefficients), and the contributions thereto by the individual (spherical) refracting surfaces of a centred system. A detailed example is provided. A.

535.317.8

1990. LAMINATED LENS. M.V.R.K.Murty.
J. Opt. Soc. Amer., Vol. 46, No. 11, 998-9 (Nov., 1956).

A lens is made of a number of laminations whose refractive indices vary continuously. The condition for freedom from spherical aberration is given. For a plano-convex lens, residual coma limits the use to condenser or field lenses. A bi-convex lens of symmetrical construction will be free from coma and can be used for image formation. R.W.Fish

535.32 : 535.35

1991. TABLES FOR QUICK CALCULATION OF OPTICAL CONSTANTS AND VARIATION OF THE ELLIPSE OF VIBRATION WITH ANGLE OF INCIDENCE. P. Crosby.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 955-6 (Sept., 1956).

The equations determining the refractive index n and the extinction coefficient k may be written in the form (φ = angle of incidence): $k^2 - n^2 = 2 \sin^2\varphi \tan^2\varphi A - \tan^2\varphi$, $2nk = 2 \sin^2\varphi \tan^2\varphi B$ where A, B are expressions involving (a) the phase difference Δ between the reflected components R_p and R_s respectively parallel and perpendicular to the plane of incidence, and (b) the angle $\psi = \tan^{-1}R_p/R_s$. The tables give A and B to four significant figures for all combinations of Δ and 2ψ at degree intervals in the range $0^\circ < \Delta < 180^\circ$ and $45^\circ < 2\psi < 90^\circ$. The tables are kept in the Physical Society (London) archives and at the Science Library, South Kensington, London. L.Pincherle

535.321

1992. BREWSTER ANGLE APPARATUS FOR THIN FILM INDEX MEASUREMENTS. A.C.Traub and H.Osterberg.
J. Opt. Soc. Amer., Vol. 47, No. 1, 62-4 (Jan., 1957).

For refractive index measurements of solid thin films, when film absorption is negligible, the Brewster angle method described by Abelès [Compt. rend., 228, 553 (1949)] is extremely convenient. An apparatus is described which facilitates routine index measurements using this method. A corner mirror system eliminates the need for manually tracking the reflected beam as the angle of incidence is varied. Settings are reproducible to within about 0.1% of the index value under optimum conditions, the results agreeing with those of other observers. A method is described whereby the apparatus may be used for the routine measurement of the indexes of non-absorbing liquid films. A.

535.323 : 535.393

1993. OPTICAL PROPERTIES OF ZINC SULFIDE AND CADMIUM SULFIDE IN THE ULTRAVIOLET. J.F.Hall, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1013-15 (Dec., 1956).

The index of refraction and the extinction coefficient of thin films of zinc sulphide and cadmium sulphide evaporated on quartz substrates were determined in the spectral range from the visible to 2100 A. The optical properties were calculated from reflectance and transmittance measurements made with a Beckman DK spectrophotometer equipped to measure specular reflectance. The index of refraction and the extinction coefficient of zinc sulphide have maxima at 2300 A and 2150 A, respectively. There is a maximum of the extinction coefficient of cadmium sulphide at 2300 A. The refractive index of cadmium sulphide has a maximum at 2500 A and a subsidiary maximum at 5000 A. There is a region of anomalous dispersion from 4000 A to 5000 A and a contribution to the absorption which are probably associated with the excitation of valence electrons into the conduction band. A.

535.323

1994. ON THE ARTICLE BY F.NECHAĬ "ON THE POSSIBILITY OF MEASURING THE REFRACTIVE INDEX OF CRYSTALLINE MATERIALS IN AN ABBE-TYPE REFRACTOMETER".
G.N.Rautian and B.V.Ioffe.
Zh. tekh. Fiz., Vol. 26, No. 9, 2129-30 (1956). In Russian.

See Abstr. 8648 (1956). The authors are surprised and therefore reject what are called Nechaĭ's obvious deviations from elementary laws of refractometry. They maintain that any arbitrary liquid cannot be used for making contact, and that the method proposed is without value since anisotropy is ignored. J.Jacobs

535.327.3 : 531.758

1995. QUANTITATIVE MEASUREMENT OF GAS DENSITY BY MEANS OF LIGHT INTERFERENCE IN A SCHLIEREN SYSTEM.
E.B.Temple.
J. Opt. Soc. Amer., Vol. 47, No. 1, 91-100 (Jan., 1957).

Plane wave fronts in a collimated beam of light are distorted in their passage through a region of variable density, and as a result a variable phase distribution is produced in an exit plane which lies just beyond the disturbance and is perpendicular to the direction of propagation of the collimated beam (optical axis). This phase distribution, ordinarily invisible due to the tremendous rapidity of optical oscillations, can be converted to an intensity distribution in which the maxima and minima of intensity correspond to points in the exit plane where the optical path length differs from that in an undisturbed portion of this plane (free field) by an integral multiple of half a wavelength. This can be done in a conventional schlieren system by forming an image of the exit (object) plane with a convex lens (or parabolic mirror) and then inserting a small absorbing object or other appropriate modification in the focal plane in such a way as to block the central maximum of the Fraunhofer pattern due to the free field. Very little disturbance light is cut off in the process since this light is refracted and does not go through the focal point. The blocking of free-field light sets up a diffraction process which causes this light to spread into the bordering disturbance image. The resulting interference produces the intensity band system mentioned earlier. If the disturbance is two-dimensional, with density gradient vectors perpendicular to the optical axis, the measurement of the phase distribution is equivalent to a measurement of density, by virtue of the Dale–Gladstone law, $\mu - 1 = K\rho$, where μ is the index of refraction, ρ is the density, K is a constant. Measurements which have heretofore required the use of a Mach–Zehnder interferometer can, therefore, be made in a conventional schlieren system. The possibility of duplicating interferometer fringe-field experiments has also been investigated. A.

535.33.03 : 535.35

1996. EXCITATION MECHANISM OF ARC SPECTRA LINES FROM A STUDY OF CADMIUM ARC SPECTRA. A.K.Dutta and U.Gantayet.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1046-8 (Dec., 1956).

Possible changes of intensity of cadmium arc lines, emitted from different upper energy states, have been calculated on the basis of thermal equilibrium for two definite temperatures of the arc due to variation of the arc current. The arc temperatures were measured with optical pyrometers. Large discrepancies were noted between the calculated and observed values. The results call for a considerable amount of collisional excitation. A.

535.33.03 : 539.153

1997. MEASUREMENT AND ANALYSIS OF THE OPTICAL EXCITATION FUNCTION OF THE 2537 A MERCURY LINE.
H.M.Jongerius, W.van Egmond and J.A.Smit.
Physica, Vol. 22, No. 9, 845-8 (Sept., 1956).

Describes measurements of the excitation function (electron impact in Hg vapour) and discusses the data in terms of the Hg energy level system, with special reference to contributions to the upper level of the 2537 A line ($6\,^3P_1 - 6\,^1S_0$) from higher levels. Some absolute data for the lines 4358 and 4078 A are given and an absolute cross-section (8.4 eV electrons) for 2537 A of 0.035×10^{-16} cm^2/steradian. J.D.Craggs

535.33.07

1998. DIFFRACTION THEORY OF ENERGY RELATIONS IN SPECTROSCOPIC MONOCHROMATOR PERFORMANCE.
J.W.Perry.
Problems in contemporary optics, Arcetri-Firenze (1956) Istituto Nazionale di Ottica, 265-84.

The formation of a finite image in a spectroscope is considered as a diffraction phenomenon and relations in terms of absolute energy distribution are derived for strictly monochromatic, broad line and continuous sources. The results are applied to spectrometers in which the spectrum is scanned by a finite exit slit and photoelectric receiver and also are used to deduce the monochromator output with a continuous source. R.W.Fish

535.33.07 : 535.339

1999. SIMPLE MONOCHROMATOR FOR THE INFRARED.
R.B.Beevers, G.K.T.Conn and J.Hampson.
J. Opt. Soc. Amer., Vol. 46, No. 11, 997-8 (Nov., 1956).

With the slits placed above the collimating mirror, aberrations due to the off-axis position of the latter are minimized. A simple slit construction is described. With an additional plane mirror the beam may traverse the prism four times. G.F.Lothian

535.33.07

2000. ANALYSIS OF ATOMIC SPECTRA WITH ELECTRONIC DIGITAL COMPUTERS. K.G.Kessler, S.B.Prusch and I.A.Stegun.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1043-5 (Dec., 1956).

A method has been developed for the analysis of atomic spectra with high speed electronic digital computers. The conversion of wavelength in air to vacuum wave-numbers, the search for spectral terms, and the construction of square arrays are performed by machine computation. These techniques are applied to the analysis of the arc spectrum of ruthenium. A.

535.33.07

2001. HIGH-SPEED WIDE-RANGE FLUORITE SPECTROGRAPH.
C.J.Silvernail.
J. Opt. Soc. Amer., Vol. 47, No. 1, 23-6 (Jan., 1957).

A plane-grating spectrograph using a movable calcium fluoride camera corrector lens has been designed and constructed. It can be used to cover a wavelength range from about 12 000 A to 1500 A. The dispersion is approximately 58 A/mm, in the first order. The camera focal ratio of f/2 gives the instrument a speed such that for relatively weak sources, the exposure times have been reduced from several weeks to a number of hours. A.

535.331

2002. NEWLY OBSERVED LINES IN He I. C.J.Humphreys and E.Paul, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 11, 999 (Nov., 1956).

Use of electrodeless discharge tubes has led to the observation and identification of eight new lines in the interval $1.28\mu < \lambda < 2.12\mu$. Their wavelengths agree well with the accepted term scheme. L.Pincherle

535.332

2003. STRUCTURE OF THE SPECTRUM OF SINGLY IONISED BROMINE. Y.Bhupala Rao.
Indian J. Phys., Vol. 30, No. 2, 95-6 (Feb., 1956).

A fresh study of the spectrum of Br II between 9000 A and 400 A, giving about 80 new levels which are listed with designations and J-values. About 250 additional lines have been classified. S.T.Henderson

535.332

2004. STRUCTURE OF THE SPECTRUM OF DOUBLY IONISED BROMINE. Y.Bhupala Rao.
Indian J. Phys., Vol. 30, No. 7, 371-4 (July, 1956).

A fresh study of the spectrum of Br III between 10 000 A and 400 A, by which former work is corrected and many lines classified. The designation and J-values of about 70 newly identified levels are listed. S.T.Henderson

535.332

2005. SPECTROSCOPIC EVIDENCE FOR PRESENCE OF ATOMS IN ACTIVE NITROGEN. D.T.Stewart.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 956-7 (Sept., 1956).

An afterglow was generated in streaming gas. Its spectrum presented an isolated line at 3466.5 ± 0.3 A at pressures of from 2 to 10 mm Hg with exposure times of from 2 to 4 hours. The line can be identified as the unresolved doublet $^4S-^2P$ of N I, thus indicating that N atoms in the metastable ^2P-state are present in the afterglow. L.Pincherle

535.333

2006. NEAR INFRARED EMISSION SPECTRUM OF THE H, O_3 REACTION. T.M.Cawthon and J.D.McKinley,Jr.
J. chem. Phys., Vol. 25, No. 3, 585-6 (Sept., 1956).

The reaction produces O_2 and OH. The frequencies of the P branch lines of the vibrational overtone bands of OH are listed for the region 7000-10 000 A. The bands are interpreted by values of v up to 9 and of Δv equal to 4 and 5. The energy of OH ($^2\pi, v = 9$) is comparable to the reaction energy. Search for the OD spectrum in the corresponding reaction was unsuccessful. G.F.Lothian

535.333 : 541.126 : 536.46

2007. THE FORMATION OF CARBON PARTICLES IN FLAMES AND OBSERVATIONS ON THE C_3 MOLECULE. F.Cabannes.
J. Phys. Radium, Vol. 17, No. 6, 492-6 (June, 1956). In French.

A review of proposed mechanisms for the formation of soot particles and of observations on the 4050 A band group of C_3 and related continuous spectra. A.G.Gaydon

535.333

2008. ACHROMATIC BEAM TRANSLATION SYSTEMS FOR LINEAR ACCELERATORS. K.L.Brown.
Rev. sci. Instrum., Vol. 27, No. 11, 959-63 (Nov., 1956).

The beam of electron linear accelerators had desirable geometric properties, but usually contains undesirable secondary particles and a relatively broad energy spectrum. In order to dispose of the secondary particles and, at the same time, establish control of the width of the energy spectrum, several magnetic deflection systems have been considered for the Stanford machines. Two such systems are described here, one of which has been adopted for three accelerators. Both systems are capable of translating the beam without energy dispersion. A.

535.333

2009. THE FINE STRUCTURE OF THE He^+ LINES 1640 A AND 4686 A. G.Herzberg.
Z. Phys., Vol. 146, No. 3, 269-80 (1956). In German.

The discharge tube was held at liquid N_2 temperature, and the He pressure between 0.1 and 6 mm Hg. Absolute wavelengths were not sought from the spectrograms, but line separations were measured for six of the seven observed components in the 1640 A line, and for seven of the eight observed in 4686 A. Theoretical components number seven and eleven, respectively. The separations do not agree with the Dirac theory, but agree closely if the Lamb shift of the 2, 3 and 4 ^2S levels is included. Spectrograms, photometer curves and energy level diagrams are given. Line components with their upper state at the 3 or 4 ^2S levels are of abnormally high intensity compared with the theoretical values, since at the low pressure or current required to show this effect the ^2S states are more highly populated, owing to their long lifetimes, than the statistical calculation allows. S.T.Henderson

535.333

2010. THE INFRA-RED RESONANCE LINES OF LUTETIUM. L.F.H.Bovey, E.B.M.Steers and H.S.Wise.
Proc. Phys. Soc. A, Vol. 69, Pt 10, 783-4 (Oct., 1956).

The lines belonging to the transitions $^2D_{3/2}-^2P_{3/2}$, $^2D_{5/2}-^2P_{3/2}$ and $^2D_{3/2}-^2P_{1/2}$ have been found in the predicted positions by examination of the emission spectrum of lutetium oxide at 2400° C, at 7476.2, 5482.6 and 4136.3 cm^{-1}. C.Turner

535.34

2011. SECONDARY AND TERTIARY INTERFEROMETRIC WAVELENGTH STANDARDS IN THE 1.5-2.5 μ REGION. D.H.Rank, A.H.Guenther, J.N.Shearer and T.A.Wiggins.
J. Opt. Soc. Amer., Vol. 47, No. 2, 144-8 (Feb., 1957).

Methods previously developed have been used to measure interferometrically the wavelengths of three absorption lines relative to the Hg^{198} green line. The results are: P(1), 002-000 band of HCN, 15 345.288$_7$ A in vacuum; R(15), 01^11-000 band of HCN, 24 700.065 A in vacuum; R(18), 2-0 band of CO, 23 150.023 A in vacuum. The P(1) line is believed to have an absolute accuracy of 1 part in 10^7. The absolute accuracy of the other two lines is thought to be 1 part in 5×10^6. In addition, twenty-nine lines of the 002-000 band of HCN have been measured relative to P(1). The relative accuracy of these determinations is 1 part in 1.5×10^7. A.

535.34.07

2012. SLIT FUNCTION EFFECTS IN THE DIRECT MEASUREMENT OF ABSORPTION LINE HALF-WIDTHS AND INTENSITIES. H.J.Kostkowski and A.M.Bass.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1060-4 (Dec., 1956).

The distortion of spectral lines by the finite band-pass of spectrometers is an effect which must be considered in measuring line shape parameters. The differences between actual line half-widths and line intensities and those which would be obtained directly from measurements by spectrometers with Gauss and Cauchy shaped slit functions have been calculated for Lorentz and Doppler lines of varying widths and intensities. A method of utilizing these results to correct actual measurements is developed. A.

535.34.07

2013. INTERNALLY HEATED CELL FOR SPECTROSCOPIC WORK AT HIGH PRESSURES AND HIGH TEMPERATURES. J. Robin and S.Robin.
J. Phys. Radium, Vol. 17, No. 6, 499-500 (June, 1956). In French.

The electrically heated cell has been used up to 1100° C and 1500 kg/cm^2; under these conditions the transparancy of the quartz windows soon deteriorates. G.F.Lothian

535.34.07

2014. APPARATUS FOR SPECTROGRAPHIC STUDIES UP TO 6000 ATMOSPHERES. J.Robin and B.Vodar.
J. Phys. Radium, Vol. 7, No. 6, 500-1 (June, 1956). In French.

Gases are compressed by heating a reservoir containing the gas that has been solidified under pressure in liquid N_2. The absorption cell connected to the reservoir is similar to that described in the previous abstract. Safety precautions are described. G.F.Lothian

535.34.07

2015. A MECHANICAL SLIT CONTROL FOR A RECORDING SINGLE-BEAM INFRARED SPECTROMETER. E.Funck.
Optik, Vol. 13, No. 10, 433-6 (Oct., 1956). In German.

The micrometer screw of the slit is controlled by a disk cam coupled to the wavelength drum; the shape of the cam is adjusted to give a constant output for $\lambda = 2.5 - 8\mu$. G.F.Lothian

535.34.07

2016. SIMPLE AID TO INFRARED INTENSITY MEASUREMENTS. C.B.Arends and D.F.Eggers, Jr.
Rev. sci. Instrum., Vol. 27, No. 11, 939-40 (Nov., 1956).

A device is described for the simple, accurate determination of infrared absorption intensity directly from spectral curves. Variations in incident energy and stray light will not introduce errors. Comparison with the conventional method on some bands of isotopic carbon dioxide shows the same integrated intensity, but a great saving in time by this device. A.

535.34.07

2017. HIGH-RESOLUTION MICROWAVE ZEEMAN SPECTROMETER. R.W.R.Hoisington, C.Kellner and M.J.Pentz.
Nature (London), Vol. 178, 1111-12 (Nov. 17, 1956).

A Zeeman effect microwave spectrometer working at about 3000 Mc/s using a cavity sample cell in the magnetic gap has been constructed and used to measure molecular g factors. For NH_3

$g = 0.490 \pm 0.008$ from the (J,K) = (12,12), (13,13), (14,14) and (15,15) inversion lines and the Zeeman effect is linear up to 0.5 weber/metre^2 This agrees with the value for the lower frequency lines (Abstr. 2025/1952) showing g to be independent of angular momentum. For $CH_3C{\equiv}CH$, $g_{zz} = 0.30 \pm 0.02$ and $g_{xx} \cong 0$. D.H.Whiffen

535.34.07

2018. EFFECT OF FLUCTUATIONS IN SLOPE ON THE SENSITIVITY OF AUTO-OSCILLATORS. M.Buyle-Bodin.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1618-21 (Nov. 19, 1956). In French.

In microwave spectroscopy the maximum sensitivity should be obtained at the start-oscillation point. However this is perturbed by noise. The low-frequency components of the noise are considered as fluctuations in slope and their effect on line-broadening is studied. A.H.W.Beck

535.343 : 539.132

2019. BUTADIENE RYDBERG SPECTRUM. A.D.Liehr.
J. chem. Phys., Vol. 25, No. 4, 781 (Oct., 1956).

Theoretical discussion of the observations of Price and Walsh (1940), using semi-empirical MO theory. J.Hawgood

535.343

2020. PERTURBATION OF THE NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF THE VAPOURS OF TOLUENE AND META-XYLENE BY FOREIGN GASES COMPRESSED UP TO 1500 kg/cm^2. B.Oksengorn.
J. Phys. Radium, Vol. 17, No. 7, 606 (July, 1956). In French.

Measurements similar to those reported earlier (see Abstr. 7851/1955) show similar results: broadening and shift to longer wavelengths, both proportional to pressure. G.F.Lothian

535.343

2021. ABSORPTION SPECTRA OF I_2 AND I_4 IN CCl_4 SOLUTION. R.M.Keefer and T.L.Allen.
J. chem. Phys., Vol. 25, No. 5, 1059-61 (Nov., 1956).

The absorption of light by solutions of iodine in carbon tetrachloride has been investigated from 250 mμ to 600 mμ. Deviations from Beer's Law occur in the region below 420 mμ. In this region the apparent extinction coefficient of the iodine is a linear function of its concentration. This can be accounted for on the basis that a weak complex of formula I_4 exists in the solution in equilibrium with the diatomic molecules: $2I_2 = I_4$. The true extinction coefficient of I_2 and the product of the formation constant and the extinction coefficient of I_4 have been determined as a function of wavelength in this region. A.

535.343

2022. APPLICATION OF VAPOR CHROMATOGRAPHY TO INFRARED SPECTROSCOPY OF LIQUIDS. H.E.Bellis and E.J.Slowinski, Jr.
J. chem. Phys., Vol. 25, No. 4, 794 (Oct., 1956).

A procedure for obtaining routine infrared spectra of chromatographically pure liquids from samples having an initial volume of less than 0.03 ml. is described. G.Allen

535.343

2023. PURE ROTATIONAL SPECTRA OF CO, NO, AND N_2O AND 600 MICRONS. E.D.Palik and K.Narahari Rao.
J. chem. Phys., Vol. 25, No. 6, 1174-6 (Dec., 1956).

The pure rotational absorption lines of carbon monoxide (CO) for J = 3 to J = 23, of nitrous oxide (N_2O) for J = 19 to J = 40, and of nitric oxide (NO) for J = $5\frac{1}{2}$ to J = $24\frac{1}{2}$ have been observed for the first time. The possibility of using lines of CO and N_2O for calibrating a far infrared spectrograph is considered. The pure rotational absorption spectrum of NO yields rotational constants of the molecule in the ground state. A.

535.343

2024. INFRARED SPECTRUM OF TCN. P.A.Staats, H.W.Morgan and J.H.Goldstein.
J. chem. Phys., Vol. 25, No. 3, 582 (Sept., 1956).

Method of preparation of TCN is described. Its vibrational frequencies are compared with calculated values and with values for HCN and DCN. G.F.Lothian

535.343 : 539.132

2025. OsO_4 : INFRARED SPECTRUM OF THE VAPOR AND COMMENTS ON THE OV F F CONSTANTS. N.J.Hawkins and W.W.Sabol.
J. chem. Phys., Vol. 25, No. 4, 775-6 (Oct., 1956).

Experiments on the vapour confirm the conclusions of Woodward and Roberts, (Trans Faraday Soc., Vol. 52, Pt 5, 615, May, 1956) from liquid and solid studies, and give fundamental vibration frequencies $V_1 = 971$, $V_2 = 328$, $V_3 = 959.7$ and $V_4 = 328$ cm^{-1}, the near coincidences accounting for the very simple spectrum. These frequencies are not self-consistent when interpreted by orbital valency force field calculations (see Abstr. 3367, 4912/1949). J.Hawgood

535.343

2026. INFRARED SPECTRA OF SELENIUM HEXAFLUORIDE AND TELLURIUM HEXAFLUORIDE. T.G.Burke.
J. chem. Phys., Vol. 25, No. 4, 791-2 (Oct., 1956).

Assignments of the observed bands are made. Good agreement has been obtained with the results of Gaunt and an explanation of the differences is attempted. The results confirm the regular octahedral structure of these molecules. G.I.W.Llewelyn

535.343

2027. INTENSITY AND LINE-WIDTH OF THE 15-MICRON CO_2 BAND, DETERMINED BY A CURVE-OF-GROWTH METHOD. L.D.Kaplan and D.F.Eggers, Jr.
J. chem. Phys., Vol. 25, No. 5, 876-83 (Nov., 1956).

The intensity has been redetermined by a curve-of-growth method, utilizing simple formulae derived for the absorption coefficient of the Q branch. The value obtainable is 240 cm^{-1} per cm at S.T.P., some 25 to 30% higher than the results of the Wilson–Wells method. Extrapolation methods in general can lead to considerable underestimation of intensity, especially when applied to bands containing narrow Q branches. The nitrogen-broadened half-width at one atmosphere and 298 K is 0.064 cm^{-1}. A.

535.343

2028. INFRARED SPECTRUM OF WATER VAPOR. I. THE 6.26μ REGION. F.W.Dalby and H.H.Nielsen.
J. chem. Phys., Vol. 25, No. 5, 934-40 (Nov., 1956).

The absorption spectrum of water vapour has been measured from 5.26μ to 7.14μ. The spectra were observed with a Pfund-type vacuum spectrometer employing a 4500-line-per-inch echelette grating as the dispersing element. Lines separated by intervals of the order of 0.1 cm^{-1} were resolved. The rotational analysis leads to the following molecular constants for the H_2O bending vibration: $\nu_0 = 1594.78 \pm 0.10$ cm^{-1}; $A = 31.20_0 \pm 0.01$ cm^{-1}; $B = 14.67_9 \pm 0.005$ cm^{-1}; $C = 9.15_0 \pm 0.005$ cm^{-1}. A.

535.343 : 539.133

2029. INFRARED SPECTRUM AND STRUCTURE OF THE THIOCYANATE ION. L.H.Jones.
J. chem. Phys., Vol. 25, No. 5, 1069-72 (Nov., 1956).

The infrared absorption spectra of aqueous and solid KNCS have been studied (the latter in detail) from 280-10 000 cm^{-1}. The fundamental frequencies of NCS^- in aqueous solution are $\nu_1 = 2066$, $\nu_2 = 470$, and $\nu_3 = 743$ cm^{-1}. In the solid, the degeneracy of the bending vibration is removed and four fundamentals are observed at 2053, 484, 470 and 749 cm^{-1}, respectively. Many combination bands were observed for solid KNCS from which the anharmonicity constants and the frequencies for infinitesimal amplitudes of vibration were calculated. The fundamental frequencies of the C^{13} and S^{34} isotopic species were observed also. From the zero-order frequencies, force constants were calculated for NCS^- in KNCS as $k_{N-C} = 15.95$ md/A, $k_{C-S} = 5.18$ md/A, $k_{12} = +0.9$ md/A, and $k_\alpha/R_{C-N}R_{C-S} = 0.311$ and 0.300 md/A. With the use of Badger's rule the bond distance are calculated to be $R_{N-C} = 1.17$ A, $R_{C-S} = 1.61$ A. These distances indicate a considerable amount of double bond character in the C—S bond. A.

535.343 : 539.133

2030. INFRARED SPECTRUM AND STRUCTURE OF PERCHLORYLFLUORIDE. D.R.Lide,Jr and D.E.Mann.
J. chem. Phys., Vol. 25, No. 6, 1128-31 (Dec., 1956).

The infrared spectrum of gaseous perchlorylfluoride, ClO_3F, has been obtained over the range 3-4μ. A satisfactory assignment has been achieved on the basis of a C_{3v} model in which the four peripheral atoms are each bonded to the central chlorine. The a_1 fundamentals occur at 1061, 715 and 549 cm^{-1}; the e fundamentals are found at 1315, 589 and 405 cm^{-1}. The stability of the C_{3v} structure for ClO_3F is discussed with reference to ClO_4^- and related molecules. A.

535.343

2031. INFRARED SPECTRUM OF HYDROGEN SULFIDE. H.C.Allen,Jr and E.K.Plyler.
J. chem. Phys., Vol. 25, No. 6, 1132-6 (Dec., 1956).

The absorption has been investigated in the 8μ region under high resolution. It has been analysed as a B-type band and assigned as the $(n_1,n_2,n_3) = (0,1,0)$ band. The resulting inertial constants

agree well with those predicted from previously analysed bands. The best values of the constants for this band are, $\nu_0 = 1182.68$ cm^{-1}, A = 10.724, B = 9.211, C = 4.670. The knowledge of this band centre, together with previously determined frequencies, enable the evaluation of the constants in the quadratic expression for the vibrational energy. A second-order resonance was found which arises from the near coincidence of the frequencies ν_1 and ν_3. A.

535.343 : 539.132

2032. INFRARED ABSORPTION OF LANTHANUM, SCANDIUM, AND INDIUM BORATE AND THE FORCE CONSTANTS OF BORATE ION. W.C.Steele and J.C.Decius.
J. chem. Phys., Vol. 25, No. 6, 1184-8 (Dec., 1956).

The infrared absorption spectra of $LaBO_3$, $InBO_3$ and $ScBO_3$ have been observed as crystalline powders in the wavelength range from 7 to 20 microns. The borates had a B^{10}/B^{11} ratio varying from the natural abundance (18/82) up to about 96/4. The four fundamental frequencies for B^{10} fell within the ranges, $\omega_1 = 939$, $\omega_2 = 740$-790, $\omega_2 = 1265$-1330, $\omega_4 = 606$-675, all in cm^{-1}. The totally symmetric frequency, ω_1 is observed only in $LaBO_3$, which has less than three-fold site symmetry, unlike the other two salts. The GVF force constants have been calculated and are compared with those of BF_3. A very strong specific coupling of the out-of-plane bending mode (ω_2) is observed in $LaBO_3$, but the fine structure is not well resolved, and only a rough estimate of the coupling constant and dipole derivative can be made. A.

535.343

2033. SHARP LINE ABSORPTION IN SILICA NEAR 3400 cm^{-1}. A.M.Bass and H.P.Broida.
J. Opt. Soc. Amer., Vol. 47, No. 2, 163-4 (Feb., 1957).

Sharp absorption lines have been observed at temperatures near 4°K in samples of fused silica and crystal quartz. The strongest lines are near 3365 cm^{-1} and 3472 cm^{-1} and have widths at half height of less than 2.5 cm^{-1}. With increasing temperature the absorption lines are shifted to higher frequencies; in addition, the lines are broadened and the peak absorption is decreased. A.

535.343

2034. STUDY OF INFRARED ABSORPTION SPECTRA OF ORDINARY AMIDO-SULPHONIC ACID, HEAVY AMIDO-SULPHONIC ACID AND THEIR SALTS. T.Dupuis.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1621-3 (Nov. 19, 1956). In French.

Vibration bands of the acid and of the salts of ammonium and barium indicate that in the solid state the acid exists in the two forms $NH_2.SO_2OH$ and NH_3^+-SO_3^-. G.F.Lothian

535.343

2035. INFRARED ABSORPTION SPECTRUM OF 2,4,6,8,9,10-HEXA-THIAADAMANTANE. H.Spiesecke and R.Mecke.
J. chem. Phys., Vol. 25, No. 3, 577 (Sept., 1956).

Observed bands at 1202, 1176, 1174, and 1107 cm^{-1} are attributed to CH deformation. Of the six predicted bands of the valency vibration of the C–S bonds only three were observed (776, 736 and 611 cm^{-1}). This anomaly is attributed to the strong van der Waals forces between the molecules in the lattice. G.I.W.Llewelyn

535.343

2036. USE OF PARTIALLY ORIENTED SAMPLES AND UNPOLARIZED RADIATION IN THE ANALYSIS OF INFRARED ABSORPTION SPECTRA OF p-DICHLOROBENZENE. K.M.M.Kruse.
J. chem. Phys., Vol. 25, No. 3, 591-2 (Sept., 1956).

The ratios of extinction coefficients for two differently oriented specimens are used to assist in the assignment of the nine vibrations covering 3077-820 cm^{-1}. Only four agree with the assignments of Stewart (Abstr. 6923/1955); the discrepancies are discussed and are being investigated. G.F.Lothian

535.343

2037. VIBRATIONAL SPECTRA FOR OXALATE ION AND OXALIC ACID. H.Murata and K.Kawai.
J. chem. Phys., Vol. 25, No. 3, 589-90 (Sept., 1956).

Raman displacements and infrared frequencies have been obtained for potassium oxalate and oxalic acid. The F- and G- matrix elements are given and the observed and calculated frequencies compared for the oxalate ion. G.I.W.Llewelyn

535.343

2038. VIBRATIONAL SPECTRA OF DIAZINES. M.Ito, R.Shimada, T.Kuraishi and W.Mizushima.
J. chem. Phys., Vol. 25, No. 3, 597-8 (Sept., 1956).

The observed Raman and infrared frequencies and the depolarization data of Raman lines are tabulated for pyrazine, pyrimidine, and pyridazine. Results indicate that the pyrazine molecule belongs to a V_h symmetry point group, whilst pyrimidine and pyridazine belong to a lower symmetry group, probably C_{2V}. G.I.W.Llewelyn

535.343

2039. VIBRATIONAL SPECTRA FOR OXALATE ION IN COORDINATION COMPOUNDS. H.Murata, K.Kawai and J.Fujita.
J. chem. Phys., Vol. 25, No. 4, 796 (Oct., 1956).

Infrared and Raman spectra have been obtained for oxalate ions in $K_3[Al(Ox)_3]3H_2O$. Since coincidences are observed in the spectra, it is inferred that the $(COO)_2^{2-}$ ions in the complex in the complex have the cis-form (point group C_{2V}) instead of the normal plane symmetrical form. Potential constants are given and the calculated frequencies are compared with the observed values. G.Allen

535.343

2040. INFRARED SPECTRA OF POLYMERS. I. EFFECT OF CRYSTALLINITY ON THE INFRARED SPECTRUM OF POLYETHYLENE AND ON THE INFRARED SPECTRA OF NYLON 6 AND NYLON 11. M.C.Tobin and M.J.Carrano.
J. chem. Phys., Vol. 25, No. 5, 1044-52 (Nov., 1956).

The melt and polarization spectra of dotriacontane and polyethylene in the 750-1500 cm^{-1} region and of Nylon 6 and Nylon 11 in the 450-4000 cm^{-1} region are presented. In addition, the melt and crystal spectra of stearone are presented in the 650-3500 cm^{-1} region. The effect of crystallinity on the spectrum of polyethylene is discussed. With the aid of published Raman spectra of crystalline hydrocarbons, an assignment of frequencies for polyethylene is made. The effect of crystallization on the spectrum of stearone is discussed and unusual features pointed out. Orientations in films of Nylon 6 and Nylon 11 are shown to be in the extrusion direction. The effect of melting on the hydrogen bonding and on the CO and NH frequencies is discussed. A partial assignment and classification of frequencies is made. When the films are melted, certain peaks vanish. These are ascribed to splitting arising from crystal forces. A.

535.343

2041. MAGNETIC PERTURBATION OF THE LOWEST TRIPLET STATES OF AROMATIC MOLECULES BY DISSOLVED OXYGEN. D.F.Evans.
Nature (London), Vol. 178, 534-5 (Sept. 8, 1956).

Experimental study of the absorption spectra of benzene and naphthalene saturated with O_2 and N_2 showed that the singlet-triplet bands are greatly intensified by the O_2, and disappear with N_2 dissolved, the effect being due to spin-orbit perturbation of the triplet level by the O_2 molecule. The new experiments contradict those reported in Abstr. 1739/1951, which described a shoulder near 2900 A and a band near 3507 A in the benzene spectrum. J.Hawgood

535.343

2042. OPTICAL ABSORPTION IN LIQUID SULPHUR–SELENIUM CO-POLYMERS. R.A.Hyman.
Proc. Phys. Soc. B Vol. 69, Pt 11, 1085-8 (Nov., 1956).

The position of the optical absorption edge in a range of sulphur–selenium copolymers has been determined as a function of temperature and composition. The temperature dependence of the absorption edge is -1.8×10^{-3} eV deg^{-1} in selenium and copolymers containing up to 84 atomic % sulphur; and -2.9×10^{-3} eV deg^{-1} in sulphur. A.

535.343 : 539.133

2043. SEARCH FOR MICROWAVE ABSORPTION IN PERCHLORYLFLUORIDE. D.R.Lide,Jr and D.E.Mann.
J. chem. Phys., Vol. 25, No. 3, 595 (Sept., 1956).

Microwave absorption lines for ClO_3F could not be detected. With the sensitivity employed this indicates that the dipole moment must be < 0.09 D. D.H.Whiffen

535.343 : 539.133

2044. STRUCTURE OF PERCHLORYLFLUORIDE FROM HIGH-RESOLUTION INFRARED SPECTRA. R.P.Madden and W.S.Benedict.
J. chem. Phys., Vol. 25, No. 3, 594-5 (Sept., 1956).

Higher resolution measurement confirms the results of the preceding abstract that ClO_3F has C_{3v} symmetry. J.Hawgood

535.343

2045. MILLIMETER-WAVE LINES OF HEAVY WATER. G.Erlandsson and J.Cox.
J. chem. Phys., Vol. 25, No. 4, 778-9 (Oct., 1956).

Transitions in HDO and D_2O up to 250 000 Mc/s are observed and assigned. D.H.Whiffen

535.343

2046. MICROWAVE SPECTRUM OF NO_2: A RIGID ROTOR ANALYSIS. G.R.Bird.
J. chem. Phys., Vol. 25, No. 5, 1040-3 (Nov., 1956).

Four new rotational lines, each of these divided into a multiplet by magnetic interactions, have been observed in the microwave spectrum of $N^{14}O_2^{16}$, bringing the total number of observed lines to five. A rigid rotor analysis has been performed to identify four of these, and probably the fifth. This new analysis removes the disagreement between McAfee's microwave assignment and Moore's infrared results, and explains the absence of $N^{15}O_2$ lines in the region search by Muller. Molecular parameters obtained are: angle ONO = 134^0 15', r_{N-O} = 1.197 A. A combination rule for magnetic fine structure spacings is discussed. General conclusions are drawn regarding future investigations of asymmetric rotor free radicals. A.

535.343

2047. FURTHER EXTENSION OF MICROWAVE SPECTROSCOPY IN THE SUBMILLIMETER WAVE REGION. M.Cowan and W.Gordy.
Phys. Rev., Vol. 104, No. 2, 551-2 (Oct. 15, 1956).

Up to the 21st harmonics of a centimetre klystron generator are detected and used to measure spectroscopic transitions. For OCS $J_{41 \rightarrow 42}$ at 510 457.3 Mc/s is detected with a recorder while $J_{35 \rightarrow 36}$ at 486 184.2 Mc/s can be seen on an oscilloscope. The $J_{0 \rightarrow 1}$ transitions of HI are centred on 385 293.27 Mc/s and the resolved fine structure leads to eqQ = 1831.0 Mc/s, c_I = 0.26 Mc/s. r_e = 1.60904 A. $J_{2 \rightarrow 3}$ of CO was observed at 345 802 Mc/s. D.H.Whiffen

535.343 : 539.133

2048. MICROWAVE SPECTRA OF THIOPHENE, 2- AND 3-MONODEUTERO, 3,3'-DIDEUTERO, AND TETRADEUTEROTHIOPHENE. STRUCTURE OF THE THIOPHENE MOLECULE.
B.Bak, D.Christensen, J.Rastrup-Andersen and E.Tannenbaum.
J. chem. Phys., Vol. 25, No. 5, 892-6 (Nov., 1956).

2- and 3-monodeutero, 3,3'-dideutero, and tetradeuterothiophene have been prepared and their microwave spectra recorded together with the microwave spectrum of ordinary thiophene (C_4H_4S). Lines originating from the 4% content of $C_4H_4S^{34}$ and the 2% content of $C_3C^{13}H_4S$ in ordinary thiophene (both the 2- and the 3-C^{13} species) were also identified. For all isotopic species rotational constants of high accuracy were obtained. The total material is sufficient for a complete determination of all the 8 geometrical parameters of thiophene. A.

535.343

2049. MICROWAVE SPECTRUM OF CHLOROFORM. P.N.Wolfe.
J. chem. Phys., Vol. 25, No. 5, 976-81 (Nov., 1956).

A theoretical and experimental examination of the J = 2 → 3 transition in $CHCl_3^{35}$ permits the evaluation of the quadrupole coupling constant of the molecule as eQV_{zz} = 28.70 ± 0.08 Mc/s, and provides an improved value of the rotational constant, B = 3302.41 ± 0.03 Mc/s. Two centrifugal distortion coefficients are also obtained: D_J = 4.12 ± 0.43 kc/s and D_{JK} = 55 ± 7 kc/s. The J = 2 → 3 transitions in $CHCl_2^{35}Cl^{37}$ yield the following, revised structural parameters for chloroform: C—H = 1.073 A, C—Cl = 1.762 A, and Cl—C—Cl = $110^0$55'. With the assumption of axial charge symmetry about the C—Cl bond direction, a, the revised bond angle gives eQV_{aa} = −80.39 ± 0.22 Mc/s for the quadrupole coupling constant in $CHCl_3^{35}$ A.

535.345

2050. ON THE ABSORPTION OF ENERGY IN SOLID THIN FILMS.
P.Rouard, D.Malé and J.Trompette.
J. Phys. Radium, Vol. 17, No. 6, 466-71 (June, 1956). In French.

A theoretical treatment of the absorption of normally incident radiation in an ideal homogeneous thin film shows that in some cases multiple reflections in thin films can lead to greater absorptions than in thicker ones. Experimental data on evaporated films of silver and gold qualitatively confirm the theory, but the rapid variation of the optical constants with thickness precludes quantitative interpretation. D.G.Avery

535.345.6

2051. SEMISOLID NICKEL SULFATE FILTER. L.A.Strait, F.M.Goyan and W.D.Kumler.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1038-42 (Dec., 1956).

The preparation and properties of a semisolid nickel sulphate—sorbitol complex are described. The absorbance curve of the complex corresponds closely with that of an approximately saturated solution of hydrated nickel sulphate in water with the advantage of a two-fold increase in absorbancy index at the peak absorption. Used as a filter component it eliminates the undesirable properties of a liquid filter. A freshly made 3.5 mm thickness of complex had an average transmittance at 2850 A of 75% which showed a slight decrease after three years. An appreciable loss of transmittance after nine years arises from the development of an absorption band at 2850 A. The relationship of this band with a temperature-sensitive band in water solutions of pure nickel sulphate is discussed. The filter remains visually clear indicating that the complex has not crystallized in nine years. A.

535.347 : 541.64

2052. INFRARED FLOW DICHROISM. G.R.Bird and E.R.Blout.
J. chem. Phys., Vol. 25, No. 4, 798-9 (Oct., 1956).

Flow dichroism has been observed in the infrared spectrum of poly-γ-benzyl-L-glutamate when a 10% solution in $CHCl_3$ is flowed through a modified absorption cell. The results confirm the α-helical structure of the polymer and allow the calculation of the orientation of the absorbing dipoles within the molecule. G.Allen

535.361.2

2053. SIMPLE ABSOLUTE METHOD FOR MEASURING DIFFUSE REFLECTANCE SPECTRA. K.Shibata.
J. Opt. Soc. Amer., Vol. 47, No. 2, 172-5 (Feb., 1957).

A simple method for measuring the absolute value of diffuse spectral reflectance has been developed. Instead of the usual integrating sphere a small sheet of opal glass is used to diffuse the light beam before it falls on the sample. A simple equation has been derived for calculating the absolute value of diffuse reflectance of the sample, which is placed behind this opal glass plate. As a test of this method, the diffuse reflectance of MgO was measured. The results showed a fairly good agreement with the previously published data. This method has two chief advantages: (1) it provides a new and independent means for measuring the absolute values of diffuse reflectances, and (2) it can be readily used for many purposes because it employs a simple attachment for commercially available recording spectrophotometers. A.

535.37 : 535.343

2054. ON THE LUMINESCENCE SPECTRA AT THE TEMPERATURE OF LIQUID NITROGEN OF VARIOUS FILMS OF CuI AND THEIR COMPARISON WITH THE ABSORPTION SPECTRA ATTRIBUTED TO EXCITON FORMATION IN THE SAME FILMS. R.Reiss.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 902-5 (Sept. 24, 1956). In French.

Evaporated films under near ultraviolet show partly resolved line spectra at 4050-4100 A and a small emission band at longer wavelengths. Fused films emit largely in a wide band between 4100 and 4250 A. In some cases there is close agreement between absorption lines and emission lines or peaks of emission bands, but some absorption lines have no corresponding emission lines, and vice versa. S.T.Henderson

535.37

2055. LUMINESCENCE OF THE SULPHIDE PHOSPHORS.
P.F.Browne.
J. Electronics, Vol. 2, No. 2, 154-65 (Sept., 1956).

Detailed theoretical and experimental studies suggest that cation vacancies cause the 0.46 μ, 0.54 μ luminescence bands of ZnS, the 0.8 μ, 1.01 μ bands of CdS and the 0.92 μ, 1.2 μ, bands of CdSe. Both the blue and green bands arise from the same centre. Anion vacancies in the lattice are thought to provide the centres for the 0.67 μ red emission of ZnS and the 2.5 μ emission of HgS. All these are interionic transitions between ions of the fundamental lattice. Overlap due to partially covalent binding ensures that there is appreciable probability of such transitions. Two energy levels in the forbidden zone are created by breaking a double homopolar bond and these are undisturbed by the presence of Cu^+ ions in the vacancy. The recently investigated infrared emissions of the sulphides are assumed to be transitions between 3p—3s mixed states, which have been perturbed by the absence of a neighbouring cation into the forbidden zone. The binding is found to be about 36% covalent. A.

535.37

2056. LUMINESCENCE IN ZnS : Cu, Cl PHOSPHORS AT HIGH Cu CONCENTRATION. T.B.Tomlinson.
J.Electronics, Vol. 2, No. 2, 166-78 (Sept., 1956).

ZnS phosphors prepared with a varied Cl content and with 0.3% added Cu, have been analysed for both Cu and Cl. There is found to be a close interdependence between the incorporated Cu and Cl, and the ratio of Cu : Cl in gram atoms per mole, is near to unity over a wide range of concentrations. This implies that there is only one copper centre, viz. Cu^+. Spectral distribution curves of emission

show that the ratio of the intensities of the blue and green-2 emission bands is a function of temperature as well as of the Cl concentration. The spectral distribution of the electroluminescence is similarly temperature dependent. A close comparison of the spectral emission distributions of the "copper-blue" and "self-blue (Zn)" bands in ZnS phosphors at various temperatures shows that there are distinct differences between them. They are not identical as other authors have recently suggested. The origin of the blue and green luminescence bands due to Cu activator is discussed. A.

535.37 : 539.11

2057. SOLID STATE LUMINESCENCE THEORY AND OSCILLATOR STRENGTHS IN KCl: Tl. R.S.Knox and D.L.Dexter.
Phys. Rev., Vol. 104, No. 5, 1245-52 (Dec. 1, 1956).

The existing quantitative treatment by Williams of the Seitz model for the KCl: Tl luminescent system has been extended to include a prediction of the oscillator strengths of the 1960 A and 2475 A absorption lines. These f values are simply related to those of the associated free-ion transitions, In the course of the computations it is found that the best available Tl^+ wave-functions are inaccurate for the free ion and are therefore not of great value for the KCl: Tl centre. Free-ion oscillator strengths are (a) computed with these functions and are (b) estimated by analysis of experimental spectra; the results of both methods, when modified for KCl : Tl, are in poor agreement with experimental f values in the solid. A review and critique are given for the present Williams dynamical treatment of the Seitz–Williams model, and it is concluded that a sensitive test for the model would be its successful prediction of the ratio of these (1960 A and 2475 A) oscillator strengths in KCl: Tl; the observed values are from three to five times as large as the predicted value. It is concluded that the KCl: Tl problem is not as well understood as it has been believed, since the existing quantitative theory (a) is subject to considerable arbitrariness in the construction of excited-state configurational coordinate curves, (b) appears to be in fortuitous agreement with experiment insofar as its quantitative predictions depend on thallous ion wave-functions, and (c) does not, in this simple extension, predict the observed ratio of oscillator strength corresponding to the electronic transitions assumed responsible for the behaviour of the centre. A.

535.371 : 537.531

2058. MEASUREMENT OF PARTICLE ABSORPTION BY X-RAY FLUORESCENCE. P.M.de Wolff.
Acta cryst., Vol. 9, Pt 8, 682-3 (Aug., 1956).

The angular variation of fluorescent intensity is demonstrated for copper filings of various sizes. J.Adam

535.371

2059. INDEX OF REFRACTION EFFECT ON ABSOLUTE FLUORESCENCE MEASUREMENTS. A.Shepp.
J. chem. Phys., Vol. 25, No. 3, 579 (Sept., 1956).

The amount of fluorescent light trapped by total internal reflections is estimated as a function of shape (rectangle, sphere, cylinder) and refractive index of the specimen. G.F.Lothian

535.371

2060. POLARIZATION OF ANTHRACENE CRYSTAL FLUORESCENCE. J.Ferguson and W.G.Schneider.
J. chem. Phys., Vol. 25, No. 4, 780 (Oct., 1956) .

Investigation of the fluorescence excited from anthracene crystals containing small amounts of tetracene has been made at room temperature, -68°C, and -196°C. A shift of the spectrum to longer wavelengths was observed with decreasing temperature for anthracene, but the tetracene spectrum remained unchanges in position. No depolarization was noted. G.I.W.Llewelyn

535.371 : 548.7

2061. EFFECT OF CRYSTAL STRUCTURE UPON THE LUMINESCENCE OF MANGANESE-ACTIVATED LITHIUM TITANATE. M.R.Lorenz and J.S.Prener.
J. chem. Phys., Vol. 25, No. 5, 1013-15 (Nov., 1956).

At -195°C, the photoluminescence spectrum of Li_2TiO_3: Mn phosphors has been found to consist of nine narrow bands in the red. This is typical of phosphors activated by Mn^{+4} ions. The phosphorescence at -195°C decays exponentially with a lifetime of 1.1 milliseconds. Disordering of the cation arrangement in the Li_2TiO_3 structure by addition of MgO or heat treatment results in a disappearance of the fine structure in the emission and its replacement by a single broad band. The phosphorescence consists of a number of faster superimposed exponential decays. These results are interpreted qualitatively in terms of the changes in interaction of the states of the Mn^{+4} ion with the crystal. A.

535.371

2062. STUDY BY INTERFERENCE FILTERS OF THE ACTION OF INFRARED ON ZnS (Cu, Pb). G.Curie.
J. Phys. Radium, Vol. 17, No. 5, 453-4 (May, 1956). In French.

By using interference filters the action of various regions of near infrared radiation on the trapped electrons in ZnS (Cu, Pb) is studied. The thermoluminescence curve is used as an indicator of changes in trapped electron distributions following irradiation. G.F.J.Garlick

535.371

2063. LUMINESCENT CENTERS IN SULFIDE PHOSPHORS. J.H.Schulman and C.C.Klick.
Phys. Rev., Vol. 104, No. 2, 548 (Oct. 15, 1956).

The conclusion of Prener and Williams (Abstr. 3636/1956) from studies of Cu^{65} formed in ZnS from Zn^{65} by K-electron capture is that an isolated copper impurity at a Zn lattice site does not constitute a luminescence centre. It is shown that this is not so since Cu^{2+} is formed whereas Cu^+ is needed for the luminescence centre. G.F.J.Garlick

535.372 : 537.311.33

2064. RECOMBINATION LIGHT EMISSION VIA TRAPS IN GERMANIUM. C.Benoit à la Guillaume.
C.R. Acad. Sci. (Paris), Vol. 243, No. 8, 704-7 (Aug. 20, 1956). In French.

By studying the spectral distribution of the emission due to minority carrier injection in germanium two peaks are observed,one at shorter wavelengths (0.72 eV) due to band-to-band recombination and another at longer wavelengths (0.53 eV) due to transitions after preliminary trapping of carriers. G.F.J.Garlick

535.372

2065. INFLUENCE OF SECONDARY FLUORESCENCE ON THE EMISSION SPECTRA OF LUMINESCENT SOLUTIONS. A.Budó and I.Ketskeméty.
J. chem. Phys., Vol. 25, No. 3, 595-6 (Sept., 1956).

535.372

2066. EFFECT OF TEMPERATURE ON THE SPECTRAL DISTRIBUTION OF BLUE EMISSION BANDS OF ZnS : I AND ZnS : Cu : I PHOSPHORS. R.E.Schrader and S.Larach.
Phys. Rev., Vol. 103, No. 6, 1899 (Sept. 15, 1956).

The temperature dependence of the blue emission of ZnS with and without copper is used to distinguish between the different centres giving the blue emission. Without copper present the peak of emission shifts to longer wavelengths with increasing temperature but with copper a reverse shift occurs. G.F.J.Garlick

535.375.5 : 539.132

2067. RAMAN SPECTRA AND FORCE CONSTANTS OF PI_3 AND AsI_3. H.Stammreich, R.Forneris and Y.Tavares.
J. chem. Phys. Vol. 25, No. 3, 580 (Sept., 1956).

The Raman spectra were determined using solutions of PI_3 in C_6H_6 and CCl_4 and of AsI_3 in $CHBr_3$ and CS_2. Four Raman shifts were observed, two polarized and two depolarized, for both substances. The force constants of the two molecules have been calculated by application of the Howard and Wilson relationships (J. chem. Phys., Vol. 2, 630, 1934) for a valence force model and a potential function with four force constants. G.I.W.Llewelyn

535.375.5

2068. VIBRATION SPECTRUM OF PIEZOELECTRIC CRYSTALS. VI. STUDY OF THE DEGENERATE VIBRATIONS OF HYDRATED BERYLLIUM SULPHATE AND OF MONOAMMONIUM PHOSPHATE. H. Poulet and J.P.Mathieu.
J. Phys. Radium, Vol. 17, No. 6, 472-4 (June, 1956). In French.

For Pt V see Abstr. 1110 (1956). An attempt is made to explain the Raman spectra of $BeSO_4.4H_2O$ and $NH_4H_2PO_4$ crystals by consideration of the doubly degenerate vibrations of the ions which compose the lattice of S_{4u} symmetry and of the differences between the transverse and longitudinal elastic waves. G.I.W.Llewelyn

535.375.55

2069. RAMAN SPECTRA OF PHOSPHOROUS TRIFLUORIDE-BORANE AND PHOSPHOROUS TRIFLUORIDE-BORANE-d_3.
R.C.Taylor and T.C.Bissot.
J. chem. Phys., Vol. 25, No. 4, 780-1 (Oct., 1956).

Raman frequencies and qualitative polarization data are presented for the two liquids at -80°C. The spectra are interpreted in terms of the C_{3v} structure. G.Allen

535.39

2070. THE EXTINCTION CROSS-SECTION COEFFICIENT OF LARGE PERFECTLY ABSORBING SPHERICAL PARTICLES.
V.B.Vouk.
Bull. Internat. Acad. Yougoslave Cl. Sci. Math. Phys. Tech., Vol. 12, 65-71 (1954).

The coefficient is calculated in terms of the particle size and the solid angle subtended by the measuring instrument.
Mathematical Reviews

535.391 : 535.345.6

2071. DISPERSION OF THE PHASE CHANGE FOR DIELECTRIC MULTILAYERS. APPLICATION TO THE INTERFERENCE FILTER.
P.W.Baumeister and F.A.Jenkins.
J. Opt. Soc. Amer., Vol. 47, No. 1, 57-61 (Jan., 1957).

A Fabry–Perot interferometer having quartz plates coated with nine-layer dielectric films is used to study the dispersion of the phase change that occurs on reflection from such films. Using the secondary wavelength standards from the iron arc, it is shown that the method of exact fractions may be employed to establish the correct numbering of orders, but that it must be combined with a theoretical calculation of the phase change. The dispersion of phase change for the recently developed broad-band multilayers is found both theoretically and experimentally (by the use of Fizeau fringes) to be as much as 17 times as great as for the conventional multilayers. This fact gives unique properties to an interference filter incorporating two such multilayer films. Chief among these is the existence of several very narrow pass-bands, and an insensitivity to variations of the spacer thickness. A.

535.393 : 535.345

2072. EXPERIMENTAL STUDY OF THE OPTICAL PROPERTIES OF LIQUID Hg AND LIQUID Ga IN THE WAVELENGTH RANGE OF 0.23 μ TO 13 μ. L.G.Schulz.
J. Opt. Soc. Amer., Vol. 47, No. 1, 64-9 (Jan., 1957).

Methods previously developed for studying the optical properties of solid metals were modified to permit their use for studying liquid Hg and liquid Ga. Reflectivities were measured at an angle of incidence of 45° at glass–metal, quartz–metal and NaCl–metal interfaces in the wavelength range of 0.23 μ to 13 μ. In a second type of experiment the phase change accompanying reflection at normal incidence at a mica–metal interface was measured in the range 0.4 μ to 0.87 μ. In this shorter wavelength range the two measured quantities, reflectivity and phase change, were used to compute the optical constants n and k. The values thus obtained agreed to within the experimental accuracy with those calculated with the Drude free electron theory. The fact that the experimentally determined reflectivity for the complete range of 0.23 μ to 13 μ agreed closely with that predicted by the Drude theory strongly suggests that the theory applies throughout this entire wavelength range. A.

535.393

2073. COMPARISON OF CALCULATED AND EXPERIMENTAL VALUES FOR THE OPTICAL REFLECTIVITY OF THE LIQUID ALLOYS Hg–In, Hg–Tl, Ga–In AT 25°C. L.G.Schulz.
J. Opt. Soc. Amer., Vol. 47, No. 1, 70-2 (Jan., 1957).

The optical reflectivity at 25°C of three liquid alloys Hg–In, Hg–Tl, and Ga–In was measured in the wavelength range of 0.3 μ to 10 μ. Measurements were made at glass–metal, quartz–metal, and NaCl–metal interfaces by a method previously used for pure Hg and pure Ga. Experimental values thus obtained were compared with those obtained by calculation using the Drude free electron theory. It was found that when two metals of different chemical valence were combined, divalent Hg with trivalent In or divalent Hg with trivalent Tl, there was considerable disagreement of experimental and calculated values for the reflectivity. Moreover, the disagreement was of a different character for each of these two alloys. This result indicates that when two liquid metals each of which follows the Drude theory are combined, Hg and In for example, the resulting alloy does not necessarily follow the theory as was suggested by the early work of Kent. On the other hand, when two trivalent metals, Ga and In, were combined there was agreement of experiment and theory. Preliminary results of experimental measurements of the reflectivity of liquid In are also given. A.

535.393 : 539.234

2074. OPTICAL PROPERTIES AND OXIDATION OF EVAPORATED TITANIUM FILMS. G.Hass and A.P.Bradford.
J. Opt. Soc. Amer., Vol. 47, No. 2, 125-9 (Feb., 1957).

Measurements were made of the optical constants and of the reflectance and transmittance of titanium films evaporated on to fused quartz and glass. In order to prepare pure titanium films with normal density, all depositions were carried out at a pressure $< 5 \times 10^{-6}$ mm Hg and with a deposition rate > 40 A/sec. The optical constants were determined by Drude's polarimetric method from opaque films at the wavelengths 0.436μ, 0.546μ, 0.578μ and 0.650μ. The reflectance values computed from n and k agreed well with the directly measured ones. The reflectance of titanium was measured from 900 A to 10μ. 100 A to 300 A thick films of titanium were found to have quite uniform transmittance throughout the visible spectrum and can, therefore, be used as neutral density filters. Three optical principles were used to measure the oxidation of titanium in air. At room temperature the rate of oxidation of titanium was found to be almost equal to that of aluminium (about 35 A of oxide are formed in one month). With increasing temperature, however, the oxidation of titanium increases much more rapidly than that of aluminium. A.

535.393

2075. STUDY OF THE OPTICAL CONSTANTS CHARACTERIZING THIN FILMS OF GOLD. F. Grard.
J. Phys. Radium, Vol. 17, No. 5, 414-19 (May, 1956). In French.

The optical constants determined by Goos (Z. Phys., Vol. 106, 606, 1937) for films 10 to 1000 A thick, at wavelengths from 0.265 to 1.05 μ, are interpreted in terms of the constants of the bulk metal. The changes can be explained as the effect of a progressive decrease in the strength of a resonance absorption at about 18 000 cm^{-1} as the thickness of the film decreases. D.G.Avery

535.393 : 539.234

2076. OPTICAL PROPERTIES OF THIN FILMS OF SILVER IN THE VISIBLE AND NEAR ULTRAVIOLET. J.Trompette.
J. Phys. Radium, Vol. 17, No. 6, 12S-14S (June, 1956). In French.

Measurements of reflection and transmission factors were made on evaporated layers of various thicknesses up to 72 mμ. The results are compared with those of previous workers.
D.G.Avery

535.41

2077. INFLUENCE OF LIGHT SOURCE SIZE ON INTERFERENCE. B.Marković.
J. Opt. Soc. Amer., Vol. 46, No. 11, 979-82 (Nov., 1956).

In this paper the effect of the extension of two coherent light sources on interference fringes is examined. The change in the aspect of the fringes when the coherent sources are widened in the same direction is discussed. A relation between the width of the coherent sources, the distance of the screen and the wavelength for which the interference fringes may be seen, is established. This relation is discussed in connection with some special cases. A.

535.41

2078. PHASE CONDITION FOR LIGHT INCIDENT NORMALLY ON A SEMIREFLECTING FILM. A.R.Cownie.
J. Opt. Soc. Amer., Vol. 47, No. 2, 132-6 (Feb., 1957).

It is shown that for a semireflecting film whose reflection and transmission factors are $re^{i\rho}$ and $te^{i\tau}$, the conservation of energy requires that the angle $\rho-\tau$ must lie between $\cos^{-1}(A/2rt)$ and $\cos^{-1}(-A/2rt)$ where $A = 1-r^2-t^2$. The corresponding condition for an asymmetrical film is derived. The effect of this phase condition on multiple beam reflection fringes and filters is studied theoretically. It is possible to set an upper limit to the error incurred in the calculation of reflected intensities on the usual assumption that $\rho-\tau=\pi/2$. Expressions are found for the maximum and minimum intensities with $\rho-\tau$ at its limit. It is established that a necessary condition for the reflected intensity distribution to become transmission-like is that $r + t \leq 1$. A.

535.417 : 531.715

2079. ON THE INTERFEROMETRIC MEASUREMENT OF LENGTH WITH A PHOTOELECTRIC METHOD OF OBSERVATION.
J.Terrien and J.Hamon.
C.R. Acad. Sci. (Paris), Vol. 243, No. 9, 740-2 (Aug. 13, 1956). In French.

The real image of the interference rings formed at infinity in a

Michelson interferometer is focused on an aperture behind which there is a photoelectric cell. By adjusting a compensating plane, the phase of the centre of the ring pattern may be set to a standard value and thus lengths may be measured in terms of light wavelengths. The method is more sensitive than visual or photographic measurements and with it a number of systematic errors should be avoided; it has been checked by re-determining certain wavelengths in the Hg^{198} spectrum in terms of that of the green line 5461 A, the results agreeing to $\pm 1 \times 10^{-8}$ μ. A.H.Cook

535.417 : 531.715

2080. INTERFEROMETRIC MEASUREMENT OF THE WAVELENGTH OF CERTAIN RADIATIONS IN THE NEAR INFRARED. J.Terrien and T.Masui.
C.R. Acad. Sci. (Paris), Vol. 243, No. 10, 776-7 (Sept. 3, 1956). In French.

Using a photoelectric method of observing interference fringes described previously (see preceding abstract) the wavelengths of four infrared radiations of argon and five of krypton have been compared with those of four visible radiations of mercury over a path length of 10 mm with a root mean square error of about 10^{-6} μ. With such radiations it should be possible to measure lengths of the order of 1 m. A.H.Cook

535.417

2081. POLARIZED BEAM INTERFEROMETER. B.S.Blaisse.
J. Opt. Soc. Amer., Vol. 46, No. 11, 950-2 (Nov., 1956).

An interferometer is described in which the two interfering light beams follow the same geometrical path; they differ in their direction of polarization. The interferometer is used for the measurement of a difference in the optical path between the lengths of two etalons I and II, each bounded by reflecting or semireflecting surfaces. By using plane polarized light, in each etalon a quarter wavelength plate at 45^0 with the plane of polarization, and an analyser in the 90^0 position, interference will result between a beam reflected by the top semireflecting mirror of I and the opaque one at the bottom of II, and a beam reflected by the bottom mirror of I and the top one of II. Beams of other combinations of reflections are extinguished. A.

535.417

2082. NOVEL INTERFEROMETER CONSTRUCTION. N.O.Young.
J. Opt. Soc. Amer., Vol. 46, No. 11, 996 (Nov., 1956).

An interferometer related to the system of Väisälä is described. A simplified construction is used in which the interferometer is built between the jaws of an ordinary small micrometer, the faces of the jaws acting as two parallel mirrors, a strip plate between them being mounted on the yoke. The system is rugged. S.Tolansky

535.417 : 535.345.6

2083. INTERFERENCE FILTERS FOR THE INFRARED. R.G.Greenler.
J. Opt. Soc. Amer., Vol. 47, No. 2, 130-1 (Feb., 1957).

Representative transmission curves of interference filters made with evaporated multilayers of tellurium and rock salt for the region around 10 μ are given. The filter band pass may, however, be located at any wavelength in the 5 to 20 μ spectral region. A.

535.417

2084. THE QUESTION OF CORRELATION BETWEEN PHOTONS IN COHERENT LIGHT RAYS. E.Brannen and H.I.S.Ferguson.
Nature (London), Vol. 178, 481-2 (Sept. 1, 1956).

By modifying the experimental procedure of Brown and Twiss (Abstr. 2009/1956) it is shown that there is no correlation (less than 0.01%) between photons in coherent light rays. P.M.Davidson

535.417

2085. THE PHASE ADJUSTMENT OF THE DOUBLE ETALON. H.G.Kuhn and S.A.Ramsden.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1309-11 (Dec., 1956).

When a double etalon is used in conjunction with a spectrograph, illumination from a continuous source produces heterochromatic fringes; these provide a convenient means of phase adjustment. The method offers special advantages for weak or ultraviolet lines. A.

535.42 : 535.317.1

2086. PHASE DISTRIBUTION IN AND NEAR THE BRIGHT NUCLEUS OF AN ABERRATION-FREE DIFFRACTION IMAGE. E.H.Linfoot and E.Wolf.
Nature (London), Vol. 178, 691-2 (Sept. 29, 1956).

The authors have previously reported the phase distribution in the vicinity of the diffraction image. The result of calculations extending over a wider region are given. The region here described is 2.5 times as long and 6 times as broad as the bright nucleus of the diffraction image. R.W.Fish

535.421

2087. PERFORMANCE OF AN 8 INCH BABCOCK GRATING IN A LARGE VACUUM SPECTROGRAPH. A.K.Pierce.
J. Opt. Soc. Amer., Vol. 47, No. 1, 6-14 (Jan., 1957).

To obtain true profiles of Fraunhofer lines, corrections for instrumental profile, ghosts, scattered light, etc., must be applied to the observations. A study of a 600 groove/mm Babcock grating in a high-dispersion vacuum spectrograph (8 mm/A, 5th-order, λ5461) is presented. Photographs of the hyperfine structure of the mercury line λ5769 show a resolution of 630 000 in the 5th-order. Photographs of Hg λ2536 with a microwave-excited 198 lamp as a source exhibit a weakly self-reversed line. The measured separation of the components is 0.0021 A, corresponding to a resolving power of 1 200 000 in the 11th-order. The instrumental profile, the intensities of satellite lines, and the ghost system have been determined by photoelectric scanning of the line λ5461 of isotopic mercury. A determination of the vertical apparatus function shows that its half-width is 15% wider than the theoretical value. The total intensity of the ghosts is 1.8% in the 5th-order. A brief study of polarization effects and the nature of the blaze is presented. The general spectrographic scattered light was found to be 0.7%. A.

535.421

2088. RULING OF LARGE DIFFRACTION GRATINGS WITH INTERFEROMETRIC CONTROL. G.R.Harrison, N.Sturgis, S.C.Baker and G.W.Stroke.
J. Opt. Soc. Amer., Vol. 47, No. 1, 15-22 (Jan., 1957).

The 14 inch MIT ruling engine, operated under interferometric servo-control as previously described, now rules excellent diffraction gratings up to 8 inches in width. The more recent of the 70 test gratings produced approach in quality the best yet ruled on any engine, showing resolving powers of about 600 000 in the green, and giving crisp spectral lines with low local background even at high angles. Rowland ghost intensities appear lower than any yet reported, ranging from 1/700 to 1/800 at 74^0, corresponding to 1/25 000 to 1/29 000 in the first order of a 15 000 groove/in. grating. The balls on which the blank carriage rolls were found to introduce irregularities which were finally eliminated by a rotation-control servo-mechanism which permits a carriage to be moved on curved or irregular ways over distances of 10 inches or more without rotation greater than 0.01 sec of arc. Servo-controls are described which reduce both periodic and cumulative errors to new low levels, and also eliminate "fanning" of grooves. A device for compensating the variations in the control fringe field which are produced by barometric pressure changes has now been made completely automatic. No failure of electronic components has yet occurred in the thousands of hours during which the engine has been operated. The continuous control of engine motion with interferometers makes feasible a new method for ruling wider gratings. A.

535.434

2089. TOTAL MIE SCATTERING COEFFICIENTS [K] FOR SPHERICAL PARTICLES OF REFRACTIVE INDEX 2.00. R.Penndorf.
J. Opt. Soc. Amer., Vol. 46, No. 11, 1001 (Nov., 1956).

Values of K are calculated for α up to 20; sufficient values are given to show the detailed shape of the curve up to $\alpha = 6$. A subsidiary maximum at $\alpha = 1.5$ is close to the position expected for magnetic dipole resonance. G.F.Lothian

535.434

2090. ANGULAR DISTRIBUTION COEFFICIENTS FOR RADIATION SCATTERED BY A SPHERICAL PARTICLE. G.C.Clarke, C.-M. Chu and S.W.Churchill.
J. Opt. Soc. Amer., Vol. 47, No. 1, 81-4 (Jan., 1957).

The fraction of randomly polarized radiation scattered by a spherical particle into a unit solid angle in the direction θ can be represented by the equation

$$f(\theta) = (1/4\pi) + (1/4\pi) \sum_{n=1}^{\infty} a_n P_n(\cos\theta),$$

where $P_n(\cos\theta)$ are the Legendre polynomials. Values of the angular distribution coefficients, a_n, are presented for nonabsorbing spheres with an index of refraction of 1.33 at a series of values of the ratio of circumference to wavelength of 1, 2, 3, 4, 5, 6, 8, 10, 15, 20, 25 and 30. Application of the results is illustrated. A.

535.55 : 531.25

2091. PHOTOELASTIC EFFECT IN POLYSTYRENE AND ITS HALOGEN DERIVATIVES. N.M.Bazhenov, M.V.Vol'kenshteĭn, Yu.Ya.Gotlib and L.D.Rozenshteĭn.
Zh. tekh. Fiz., Vol. 26, No. 8, 1730-7 (1956). In Russian.

Variation in time of the isothermic elongation and birefringence in films of polystyrene and its six halogen derivatives under load was measured. The maximum value of the photoelastic coefficient was found to be a constant characteristic of the substance. The values of effective anisotropies of the polarizability of polystyrene, poly-n-chlorostyrene and poly-3, 4-dichlorostyrene agree with each other if one assumes almost equal characteristics for the internal rotation in their molecules. On the other hand, it appears that the internal rotation in poly-o-chlorostyrene and poly-2,5-dichlorostyrene is markedly different from that in the other polymer molecules.
F.Lachman

535.557

2092. FLOW-BIREFRINGENCE AND STRESS. W.Philippoff.
Nature (London), Vol. 178, 811-12 (Oct. 13, 1956).

Measurements of flow birefringence Δn, of extinction angle χ of shear stress and "normal stress" as functions of flow gradient are reported. These were made with separate instruments, the substance being a 15% solution of polyisobutylene in decalin with a viscosity of about 10 000 poise. Observations were made at 30°C and 50°C in the gradient range 0.007 to 4.5 sec^{-1}. The results were considered in relation to the theory of Lodge(Abstr. 1142/1956; Trans. Faraday Soc., Vol. 52, Pt 1, 120, Jan., 1956). It is concluded that the basic assumption of stress-birefringence of solids, that is, the proportionality of Δn and the difference of the principal stresses, is equally valid for the flow-birefringence of polymer solutions. The angle χ can be used to calculate the normal stress from the shear stress and vice versa. The relationship between viscosity and χ did not satisfy the expression proposed by Buchheim and Philippoff (Naturwissenschaften, Vol. 26, 649, 1938). See also Abstr. 8029 (1956).
H.G.Jerrard

535.56 : 538.614

2093. A HIGH SENSITIVITY METHOD FOR MEASUREMENT OF THE MAGNETIC ROTATORY POWER WITH VERY WEAK ALTERNATING FIELDS. J.Breton.
C.R. Acad. Sci. (Paris), Vol. 243, No. 3, 254-6 (July 16, 1956). In French.

Details with a diagram of the arrangement are given. Two vessels, one containing the liquid under test (Verdet constant V) and the other containing pure water (Verdet constant V_0), are placed so that linearly polarized light passes through each in turn. The light then traverses an analysing prism and enters a photomultiplier. Each vessel is surrounded by a solenoid, both solenoids being identical but carrying different currents I and I_0 and wound so that the magnetic rotations in the two liquids have opposite senses. The currents are varied, but maintained rigorously in phase, until there is no resultant rotation of the plane of polarization. A knowledge of I, I_0, and V_0 enables V to be found. The accuracy is claimed to be better than 0.5%.
H.G.Jerrard

535.6.08

2094. CHROMATIC SIGNIFICANCE OF SPECTROPHOTOMETRIC ERRORS. T.Shipley and G.L.Walker.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1052-60 (Dec., 1956).

Analytic expressions are developed for describing the relationship between the maximum instrument error in the spectrophotometric measurement of coloured samples and the corresponding maximum displacement of the CIE chromaticity coordinates. Accepting some empirical evidence concerning the sensitivity of the eye to small colour differences, as recorded on the CIE colour triangle, it becomes possible to estimate the chromatic significance of this error. To illustrate this procedure, two cases were examined: constant errors and errors independent of wavelength. The effect of these errors on the chromaticity specifications of some representative blue filters was discussed. The relation of error to luminosity is also noted.
A.

535.65

2095. USE OF AN EXPONENTIAL FUNCTION TO ESTABLISH A UNIFORM CHROMATICITY SCALE. R.Taguti and M.Sato.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 654-6 (Aug. 13, 1956). In French.

So far no uniform scale of colour, analogous to the musical scale, has been established. The authors propose a function involving an exponential which gives such a scale, based on the "chromance" diagram of E.Q.Adams (J. Opt. Soc. Amer., Vol. 32, 168 1942).
J.W.T.Walsh

535.65 : 778.6

2096. QUALITY FACTOR FOR FILTERS WHOSE SPECTRAL TRANSMITTANCES ARE DIFFERENT FROM COLOR MIXTURE CURVES, AND ITS APPLICATION TO COLOR PHOTOGRAPHY. H.E.J.Neugebauer.
J. Opt. Soc. Amer., Vol. 46, No. 10, 821-4 (Oct., 1956).

Based on the theory of orthogonal colour mixture curves first published by MacAdam (Abstr. 5987/1953), a quality factor q of colour filters can be defined which is unity for colour mixture curves and a positive proper fraction for all the other filters. The difference 1-q measures the average amount of errors when an arbitrary filter is used instead of one whose spectral energy response is a colour mixture curve. The theory leads to a rather precise definition of photographic filters that match the usual primaries of colour photography and introduce less errors than other filters due to the fact that they fail to be colour mixture curves.
A.

535.65 : 621.385.832

2097. THE LUMINESCENT COLOUR OF THE PICTURE TUBE SCREEN. W.Dirbach.
Telefunken Ztg, Vol. 29, 105-8 (June, 1956). In German.

A brief lucid explanation of the C.I.E. colour diagram, of the concept of colour temperature and of the Planck curve is given. The desired colour of a monochrome cathode-ray-tube ("non-colour point") should be located within a hexagon longitudinally transversed by the Planck curve and bordered by Judd lines for 5000°K and 10 000°K. It is shown how, by a simple geometric construction from a point inside the hexagon representing the same tube viewed in different ambient light, very different hues arise (for instance bluish tint at 485 mμ and yellow tint at 575 mμ). Three methods of colorimetry of tube faces are briefly explained; the objective measurement with the aid of photocells and colour filters, the spectral analysis and the comparator method by mixture of primaries and photometer observation. A detailed description of the latter, employing an Ulbricht sphere, is given. Very useful coloured illustrations are included.
A.Landman

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84.

535.8 : 532.594

2098. APPLICATION OF THE SCHLIEREN TECHNIQUE TO THE STUDY OF RIPPLES. W.Llowarch.
Nature (London), Vol. 178, 587-8 (Sept. 15, 1956).

The usual ripple tank demonstration apparatus, modified by the addition of the schlieren technique, enables sharper patterns to be obtained. The optical system, with suitable values of components, is described and photographs of ripple patterns on water are given.
S.Weintroub

535.81

2099. GAMMA-RADIATION INSENSITIVE OPTICAL GLASSES. N.J.Kreidl and J.R.Hensler.
J. Opt. Soc. Amer., Vol. 47, No. 1, 73-5 (Jan., 1957).

Specially developed optical glasses maintain their transparency under exposures up to 10^6 röntgens of Co^{60} gamma-radiation and are usable at 5×10^8 röntgens. Ordinary optical glass colours at 10^4 röntgens or less and is nearly useless at 10^6 röntgens.
A.

535.822.17

2100. PHASE AND AMPLITUDE MODULATOR GIVING A PHASE CONTRAST EFFECT WITHOUT A PHASE PLATE. M.Locquin.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 901-2 (Sept. 24, 1956). In French.

A Fabry-Perot interference filter is used in front of a microscope objective of large numerical aperture. The filter varies the phase and amplitude according to the angle of incidence of the light. This allows a phase contrast effect to be obtained.
R.W.Fish

535.822.9 : 531.715.2

2101. MEASUREMENT OF THE DIAMETER OF OPAQUE CYLINDERS BY SCANNING MICROSCOPY. J.A.Dobrowolski, W.Godfrey, P.N.Slater and W.Weinstein.
J. Opt. Soc. Amer., Vol. 47, No. 2, 186-90 (Feb., 1957).

Experiments have been carried out to determine the systematic errors in the measurement of the diameters of opaque cylinders by scanning microscopy. It was found that for cylinders of diameter

ear the optical resolution limit, the scanning microscope gives too arge a size estimate. The variation of the error with aberrations nd numerical aperture of the scanning objective, and with the wave- ength and state of polarization of the light were determined. Optimum conditions for size determination are suggested. A.

535.824.8

102. NEW PRINCIPLE FOR FOCUSING A HIGH-POWER MICRO- SCOPE AND MEANS FOR ACCOMPLISHING THE FOCUSING AUTO- MATICALLY AND WITH GREAT ACCURACY. L.Baxter, II, .DeYoung, R.C.C.St George and W.A.Shurcliff.
. Opt. Soc. Amer., Vol. 47, No. 1, 76-80 (Jan., 1957).

A new principle for appraising and correcting the focus of a high- ower microscope is described. Besides affording greater precision han is achieved visually, the principle lends itself readily to fully utomatic operation, including "tracking" a moving slide. A servo- ystem employing this principle has been built and been operated outinely for over a year. It maintains correct focus within about .1 μ and does so over a period of several days if necessary. The quipment operates irrespective of changes in thickness and index of over slip, index of immersion fluid, thickness and flatness of speci- nen slide, temperature effects in the various optical and mechanical omponents. It operates even when the specimen slide area in quest- on is blank (i.e., unoccupied). The principle is well suited to micro- scope systems that employ photoelectric or photographic detection nd that call for the greatest possible accuracy of focus. It may be sed with u.v., visible, or i.r. radiation, and hence it is applicable to .v. and i.r. microscopy as well as visual range microscopy. Besides ssisting focusing, the new principle can be used to explore the sur- ace topography of microscopically "stepped" surfaces; unlike various ther methods it should be applicable even if the steps have an area s small as one square micron. It has been found effective also in valuating longitudinal chromatic aberration in high quality objectives. A.

535.862

2103. AIRCRAFT FLIGHT BY AN OPTICAL PERISCOPE. C.J.Campbell, L.J.McEachern and E.Marg.
J. Opt.Soc. Amer., Vol. 46, No. 11, 944-9 (Nov., 1956).

A binocular aircraft periscope has been constructed and flight tested. The periscope provided a 70° true field of view at a magni- fication of 1 x and mechanically operated azimuth and declination prisms scanned 180°. Flight instruments were included in the field of view. The periscope was installed in the nose of a B-17 aircraft together with a duplicate set of controls. Twenty impartial U.S.Air Force pilots carried out most routine flight operations competently. It is concluded that flight by this type periscope is feasible even by subjects with minimal training. A.

535.89 : 612.843

2104. SPECTRAL ENERGY CALIBRATION OF A LIGHT FLASH SOURCE USED IN PHYSIOLOGICAL EXPERIMENTS. B.Buchmann-Olsen and A.M.Rosenfalck.
J. Opt. Soc. Amer., Vol. 47, No. 1, 30-4 (Jan., 1957).

The Sylvania glow modulator tube has been used as a flash light source in physiological and psychological experiments. A setup is described for the study of colour vision. Flash duration, intensity, and colour were independently variable. The relative spectral con- centration of irradiance was determined under different working con- ditions for three types of Sylvania glow modulator tubes, R_1: IB 59/R 1130 B (new type), R_2: IB 59/R 1130 B (old type), and R_3: R 1131. The variation in relative spectral distribution was no more than 2-3% when a tube was tested regularly both over short and long time inter- vals. The relative spectral concentration of irradiance varied uni- formly as a function of peak current. It did not depend on mean cur- rent, i.e., the frequency and duration of the flashes could be varied without influence on the relative spectral concentration of irradiance as long as the peak current was kept constant. A method is described for the calibration of the total energy of the different coloured light flashes from the glow modulator tube. A.

535.89

2105. XENON FLASH TUBE OF SMALL SIZE. H.E.Edgerton and P.Y.Cathou.
Rev. sci. Instrum., Vol. 27, No. 10, 821-5 (Oct., 1956).

A xenon-filled electronic flash tube with a cylindrical lighted volume of 1.2 mm dia. and 6 mm length has been developed for use as a small source in optical systems, such as the schlieren and inter- ferometer types. The lamp has been operated at 6000 flashes per second from a hydrogen-thyratron driver circuit to record the den- sity in air flow in an interferometer. Flash duration varies from 0.3 to 3 μsec, depending upon the circuit conditions. A peak brightness of 10 million candlepower per sq cm has been achieved. A.

HEAT 536

536.2.02

2106. CALCULATION OF HEAT FLOW IN A MEDIUM THE CONDUCTIVITY OF WHICH VARIES WITH TEMPERATURE. R.L.Garwin.
Rev. sci. Instrum., Vol. 27, No. 10, 826-8 (Oct., 1956).

It is shown that the heat flow in a single homogeneous medium of thermal conductivity $\sigma(T)$, between boundaries at temperatures T_2 and T_1 is the same as that for the same geometry in a medium of unit thermal conductivity and boundary "thermal potentials" $\Sigma(T_2)$ and $\Sigma(T_1)$, where $\Sigma(T) = \int_0^T \sigma(T')dT'$. Some applications are given, as well as a short table of $\Sigma(T)$ for common cryogenic temperatures and materials. A.

536.2.02 : 538.66

2107. THE EFFECT OF A TRANSVERSE MAGNETIC FIELD ON THE THERMAL CONDUCTIVITY OF METALS. Z.Ya.Evseev.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 331 (1956). In Russian.

Employing the free-electron gas-model and standard methods of calculation the increment in the thermal conductivity is obtained as a function of the square of the magnetic field, the temperature, the mean speed and the mean free path of electrons. The increment is negative; for a field of 1000 Oe it is less than 1% of the thermal con- ductivity in absence of a field. R.Eisenschitz

536.2.083

2108. ANALYSIS OF THE "METHOD OF TWO Bi's" FOR DETER- MINING THERMAL CONSTANTS OF METALS AND INSULATORS. E.Yu.Nekhendzi.
Zh. tekh. Fiz., Vol. 26, No. 8, 1857-61 (1956). In Russian.

The author's method for determining the thermal conductivity of metals under non-stationary conditions (Abstr. 1752/1955) was tested with metal spheres of 1 and 2 cm radius. Result being unsatisfactory, the author investigates carefully the error inherent in the method. In this investigation measurements on metals and on thermal insul- ators are taken into consideration. Assuming various experimental conditions the error is calculated. The most favourable result is a relative error of approximately 6% in the thermometric conduct- ivity. R.Eisenschitz

536.212 : 537.312

2109. OBSERVED DEPENDENCE OF THE LOW-TEMPERATURE THERMAL AND ELECTRICAL CONDUCTIVITY OF GRAPHITE ON TEMPERATURE, TYPE, NEUTRON IRRADIATION, AND BROMIN- ATION. A.W.Smith and N.S.Rasor.
Phys. Rev., Vol. 104, No. 4, 885-91 (Nov. 15, 1956).

The thermal conductivity of various graphites in the tempera- ture interval 10° to 300°K has been determined and the effect of neutron irradiation and bromination investigated. The thermal con- ductivity of large crystallite natural graphite and of non-pitch- bonded graphite is found to vary as T^2 at low temperatures, as does the specific heat, in accordance with the simple theory of lattice heat conduction. This is in contrast to the anomalous $T^{2.7}$ depend- ence exhibited by various pitch-bonded graphites. The anomaly is explained in a subsequent paper (see abstract following) in terms of the effect of ungraphitized pitch on the total thermal resistivity of pitch-bonded graphites. Neutron irradiation is observed to cause the thermal conductivity of graphite to decrease markedly at a rate which decreases with exposure time. Also, the exponent of the temperature dependence decreases with exposure. The effect of bromination on the thermal conductivity of graphite is determined and compared with the effect of neutron irradiation. The results indicate that the change in the concentration of conduction electrons is not the principal mechanism by which neutron irradiation de- creases the thermal conductivity. The electrical resistivity shows a negative temperature coefficient for all graphites, except the large crystallite natural graphite. Neutron irradiation increases the elec- trical resistivity to a saturation value and decreases the magnitude of the temperature coefficient. A.

536.212

2110. INTERPRETATION OF THE LOW-TEMPERATURE THERMAL CONDUCTIVITY OF GRAPHITE. J.E.Hove and A.W.Smith.
Phys. Rev., Vol. 104, No. 4, 892-900 (Nov. 15, 1956).

The experimental data observed (preceding abstract) in measuring the low-temperature thermal conductivity of several types of graphites are interpreted on the basis of a two-medium theory. The theory assumes that, in the artificial polycrystalline graphites, the nongraphitic regions are isotropic thermal conductors and that these regions can be taken in series with the graphite particles to obtain a total conductivity. In this way, the anomalous temperature dependence of the artificial graphites can be immediately explained. Using this theory as a guide, the crystallite size of a given sample can be found in an unambiguous manner, and for the various graphite types discussed by Smith and Rasor are found to correlate with independent previous estimates. Furthermore, the observed effects of neutron damage and bromination can be readily explained in a phenomenological manner. Although this theory still needs refining in several aspects, it appears to be substantiated by all the available evidence and helps to establish the usefulness of low-temperature thermal conductivity measurements as a probe to detect internal defects and microstructure in graphite. A.

536.212

2111. TRANSIENT HEAT CONDUCTION IN SOLIDS BOUNDED BY ORTHOGONAL COORDINATE SURFACES. II. TEMPERATURE FIELD DEPENDING ON A SINGLE COORDINATE. M.G.Kogan.
Zh. tekh. Fiz., Vol. 26, No. 7, 1525-31 (1956). In Russian.

For Pt I see Abstr. 305 (1957). Sets up the differential equation for thermal conductivity for the one-dimensional case, the spherical symmetrical case and the cylindrical case; solutions are derived in terms of known mathematical junctions. J.M.Hough

536.212

2112. THERMAL CONDUCTIVITY OF ENGINEERING MATERIALS AT LOW TEMPERATURES. N.V.Zavaritskiĭ and A.G.Zel'dovich.
Zh. tekh. Fiz., Vol. 26, No. 9, 2032-6 (1956). In Russian.

Samples of material to be tested are prepared in the form of a rod. It is heated near the end and the temperature is measured at two points. By this method the thermal conductivity of copper, alloys of copper and of aluminium, stainless steel and graphite compounds is measured between 2 and 100°K. R.Eisenschitz

536.212.2 : 537.311.31

2113. THE THERMAL AND ELECTRICAL CONDUCTIVITY OF LITHIUM AT LOW TEMPERATURES. H.M.Rosenberg.
Phil. Mag. (Eighth Ser.), Vol. 1, 738-46 (Aug., 1956).

The thermal and electrical conductivity of two specimens of lithium has been measured in the range 2° to 90°K. At the lowest temperatures the ideal electrical resistivity is found to vary as $T^{3.5}$ and the lattice scattering term for the electronic thermal resistance is $1.8 \times 10^{-4}T^2$. These results and the value of the Lorenz number are compared with current theories. A.

536.23

2114. THERMAL CONDUCTIVITY OF MIXTURES OF AIR AND CARBON DIOXIDE. A.Dognin.
C.R. Acad. Sci. (Paris), Vol. 243, No. 12, 840-2 (Sept. 17, 1956). In French.

The hot wire method was used to measure the thermal conductivity, λ cal. $cm^{-1}s^{-1}deg^{-1}C$, between 20 and 70°C. The experimental results for various concentrations at 40°C are tabulated and are shownnto agree well with Wassiljewa's formula with coefficients as calculated by Lindsay and Bromley (Abstr. 8689/1950), and with the quadratic relation $\lambda = \lambda_1 x_1^2 + \lambda_2 x_2^2 + \lambda_{12} x_1 x_2$ where (λ_1, λ_2) and (x_1, x_2) are the conductivities and molecular fractions of the air and carbon dioxide respectively. λ_{12} is constant for a given temperature θ but varies with θ according to $10^7\lambda_{12} = 4.3\theta + 869$. S.Weintroub

536.252

2115. FREE CONVECTION IN VERTICAL METAL TUBES OF CIRCULAR CROSS-SECTION. V.V.Slavnov.
Zh. tekh. Fiz., Vol. 26, No. 9, 2002-4 (1956). In Russian.

This paper is concerned with convective heat transfer by liquids The onset of free convection is, according to Ostroumov, determined by the equation

$$x[J_0(x)/J_1(x) - J_0(ix)/iJ_1(ix)] = \text{constant},$$

where x^4 is proportional to the gradient of temperature, the constant depends upon the thermal conductivity of the liquid and the surrounding materials; J_0 and J_1 are Bessel functions. In order to put this equation to a test, experiments were made in which water or oil was heated from below in a tube of metal or glass. The vertical distribution of the temperature was recorded. It was found that, for a certain heat input, the quantity x was constant over an appreciable section of the tube. As a result of numerous measurements it was found that this value of x agrees within 1% with the values derived from the above equation. R.Eisenschitz

536.33

2116. THERMAL RADIATION OF GOOD CONDUCTORS. M.L.Levin.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 302-16 (1956). In Russian.

The methods of electrodynamic theory of thermal fluctuations is used to study radiation of good conductors. The radiation in the wave zone is found in the first part of the paper; the limiting cases of very short and very long waves are especially considered. Radiation from bodies with a surface anisotropy is studied. The fluctuating field near conducting surfaces (near a metallic plane, in the focus of a parabolic or centre of a spherical mirror) is considered in the second part of the paper. The fluctuating surface charges are computed. A.

536.33 : 538.56 : 535.11 : 534.23

SELF-ABSORPTION OF A RADIATING SPHERE. See Abstr. 1979-80

536.413

2117. DENSITY AND EXPANSIVITY OF SOLID ARGON. E.R.Dobbs, B.F.Figgins, G.O.Jones, D.C.Piercey and D.P.Riley.
Nature (London), Vol. 178, 483 (Sept. 1, 1956).

Results of measurements of the density, ρ, between 20 and 80°K are reported. A polycrystalline specimen was deposited from the vapour on an Al wire and in the range 20°-60°K, at which temperature recrystallization became evident, the lattice parameters were measured from Debye–Scherrer powder photographs. Above 60°K the bulk density of polycrystalline specimens was determined by finding the volume of gas at N.T.P. required to fill with solid A a glass bulb maintained at a given temperature. 99.999% pure A was used. An estimated accuracy of 10^{-3} gm.cm^{-3} is stated. Values of α (the expansivity) and γ (the Grüneisen parameter) at 20, 40, 60 and 80°K calculated from the values of ρ are given and the larger values of α than obtained previously account for the discrepancies between the values for the compressibility obtained by Stewart (Abstr. 2678/1955) and by Barker and Dobbs (Abstr. 9995/1955). S.Weintroub

536.413

2118. THE THERMAL EXPANSION OF ALUMINIUM AT LOW TEMPERATURES AS MEASURED BY AN X-RAY DIFFRACTION METHOD. B.F.Figgins, G.O.Jones and D.P.Riley.
Phil. Mag. (Eighth Ser.), Vol. 1, 747-58 (Aug., 1956).

The accurate determination of lattice cell dimensions by means of X-ray diffraction methods has been applied to the measurement of thermal expansion at temperatures down to 20°K. In the first results, obtained with aluminium, the ultimate sensitivity in the determination of values of $\Delta a/a$ (where a is the lattice parameter) is estimated to be about 5×10^{-6}. The value of $(a_{110}-a_{20})/a_{273}$ obtained is 0.613×10^{-3}. The results represent a tendency for the Grüneisen γ to increase at the lowest temperatures. A.

536.413 : 539.11

2119. THERMAL EXPANSION OF A LINEAR CHAIN. E.Bauer and T.-Y.Wu.
Phys. Rev., Vol. 104, No. 4, 914-15 (Nov. 15, 1956).

The coefficient of thermal expansion has been calculated quantum-mechanically for a linear chain of atoms interacting with their nearest neighbours through a Morse potential. A.

536.413

2120. THERMAL EXPANSION OF RARE EARTH METALS. F.Barson, S.Legvold and F.H.Spedding.
Phys. Rev., Vol. 105, No. 2, 418-24 (Jan. 15, 1957).

Thermal expansion measurements at temperatures ranging up to 900°C for polycrystalline samples of La,Ce,Pr,Nd,Gd,Tb,Dy,Er, and Yb metals are reported. La,Ce,Pr, and Nd exhibit plastic flow properties at temperatures well below their melting points. High-temperature phase transformations are reported for Pr,Nd,and Yb. The coefficient of expansion for Yb is found to be three times as large as the coefficients for the other metals reported. Negative coefficients are observed near the Curie points of Gd,Tb,and Dy. A.

536.42

2121 MASS SPECTROMETRIC STUDY OF PHASE CHANGES IN ALUMINUM, PRASEODYMIUM, AND NEODYMIUM. R.G.Johnson, D.E.Hudson, W.C.Caldwell, F.H.Spedding and W.R.Savage.
J. chem. Phys., Vol. 25, No. 5, 917-25 (Nov., 1956).

A sensitive method has been developed for measuring rapidly the latent heat of vaporization or sublimation of metals of low volatility. Atoms from the saturated vapour emerge from a small Knudsen-type effusion cell and impinge upon a hot filament. A fraction of the incident atoms re-evaporate from the filament as ions and are detected by a mass spectrometer. The Clausius—Clapeyron equation is used to obtain the latent heat from the dependence of ion current upon cell temperature. Application has been made to aluminium, praseodymium, and neodymium. The work on aluminium yielded an enthalpy of sublimation at 298° K of 78.0 ± 0.4 kcal/M. Some anomalous behaviour was observed in the rare earths. Preliminary molar enthalpy values are: Pr, 79.3 ± 2.0 kcal (vaporization at 1380° K); Nd, 70.6 ± 2.0 kcal (vaporization at 1348° K) and 74.1 ± 2.0 kcal (sublimation at 1236° K). An estimate of the heat of fusion of Nd yielded 3.5 ± 1.0 kcal/M. The method also provided a convenient measurement of first-order phase transition temperatures. The melting points of Pr and Nd were found to be 1192 ± 2° K and 1292 ± 2° K respectively. In addition, a solid-to-solid phase transition was found in Nd at 1142 ± 2° K. A.

536.421.1

2122. VARIATION OF THE AMPLITUDE OF THERMAL VIBRATION ON THE FUSION CURVE. J.J.Gilvarry.
Phys. Rev., Vol. 104, No. 4, 908-13 (Nov. 15, 1956).

A differential relation given previously (Abstr. 4358/1956), which is equivalent to the Debye—Waller identification of the Debye and Lindemann frequencies at fusion, is generalized to take into account variation along the fusion curve of the critical ratio of the root-mean-square amplitude of thermal vibration to the nearest-neighbour distance of the atoms in the solid at fusion. Thus extended, the theory yields an expression for the Grüneisen parameter of a solid at fusion in terms of fusion parameters and the rate of change of the critical ratio with respect to volume, which is valid for elements whose fusion curves have either normal or abnormal slopes. Values of derivatives of the critical ratio with respect to volume, temperature, and pressure at fusion are obtained for 16 elements. The results yield evaluations of the change in the critical ratio along the experimentally determined fusion curves for three alkali metals, and permit estimates in other cases. It is concluded that the assumption of a fixed Lindemann constant along the fusion curve of a particular element represents an excellent approximation, in general, for elements with normal fusion curves (for the case of classical excitation of the lattice vibrations). The same conclusion is obtained, within certain approximations, from the order-disorder theory of Lennard-Jones and Devonshire for the melting process, and the theory of Fisher for stability of the liquid phase. A.

536.421.4 : 548.5

2123. ORIENTATED FREEZING OF SUPERCOOLED WATER ON CRYSTALLINE SURFACES. THE CASE OF PbI_2. J.Jaffray and R.Montmory.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 891-3 (Sept. 24, 1956). In French.

PbI_2 monocrystals, deposited by evaporation on newly cleaved muscovite mica surfaces, were examined microscopically and photographically and observed to be orientated in two directions at right angles. In the more frequent orientation [010] of the mica coincided with [010] of the PbI_2, in the other [100] of the mica coincided with [010] of the PbI_2. The condensation of supercooled water drops on the PbI_2 was observed as in Abstr. 8150 (1956). The orientations [100] of the ice and of the PbI_2 were coincident. S.Weintroub

536.421.4

2124. THE NUMBER OF ICE CRYSTALS IN SUPERCOOLED WATER. D.N.Bibikov.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1123-5 (1956). In Russian.

An expression is derived giving the number of ice crystals contained in water in any interval of time, if the variation of its temperature with time and the rate of growth of ice particles are known. Experimental curves are given for dependences of temperature on time for several initial temperatures of supercooled water. From these results, calculation shows that the number of ice particles contained in water is practically constant. Z.Krasucki

536.421.4

2125. CRYSTALLIZATION OF SUPERCOOLED WATER, SUBJECTED TO TURBULENT STIRRING. A.G.Kolesnikov and V.J.Belyaev.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1129-32 (1956). In Russian.

Using the experimental results, mathematical equations are constructed, describing the process of crystallization of supercooled water. An approximate calculation is made of the number $n(\tau)$ of crystals, formed in time τ, using the experimentally determined dependence of temperature on time. In an example considered, the calculated concentration of crystals is of the same order of magnitude as that found experimentally. Z.Krasucki

536.45 : 539.89

2126. PRODUCTION OF HIGH TEMPERATURES AT HIGH PRESSURES. L.F.Vereshchagin and Ya.A.Kalashnikov.
Zh. tekh. Fiz., Vol. 25, No. 8, 1508-17 (1955). In Russian.

The few investigations in which high temperatures are obtained at high pressures by internal heating of fluids within metal vessels seem to show that (1) the electric power required for maintaining a certain high temperature increases with pressure, but (2) this phenomenon cannot be explained by the variation of heat conductivity of gases with pressure, and (3) the maximum temperature zone moves to the top of the vessel as the pressure increases. The authors' apparatus comprised a high-pressure tubular vessel with an electric tubular resistance heater inside; the pressure range was 1-1800 atm, the temperature range up to 800° C. The temperatures were measured by means of thermocouples in the centre of the vessel and near its top when vertical, or near its end when horizontal. It was found that (with N as the compressed fluid) the increase of pressure caused an increase of the temperature at the top (compared with the centre), the difference between the two temperatures also depending on the consumption of power. In the case of H, it was the centre that became hotter than the top when pressure increased. In both cases the top thermocouple readings fluctuated from ± 5 to ± 15° C. A H—N mixture and A gave results similar to those obtained with N. No temperature differentiation due to pressure could be observed when the vessel was arranged horizontally. The results (except those obtained with H) are tentatively explained by a temperature drop in a gaseous medium, occurring at higher pressures in the case of internal heating, and the vertical temperature gradients are related to convection which is bound to increase strongly with the rise of pressure. In order to prevent convection, the authors constructed a special heating element, where all gaps between the heater and the vessel were filled with refractory concrete. At p = 1 atm, with the heater arranged horizontally, the temperatures inside the heater were lower than in a system with the gap not filled with concrete; at p = 700 atm, the temperatures in the centre were higher than in a heater with gaps. The relatively low end temperature was substantially raised (almost to the level of the centre temperature) when convection inside the heater was inhibited by means of a glass-wool plug. F.Lachman

536.46 : 541.126 : 535.333

THE FORMATION OF CARBON PARTICLES IN FLAMES AND OBSERVATIONS ON THE C_3 MOLECULE. See Abstr. 2007

536.48

2127. ON THE PROBLEM OF THE STATIC HELIUM FILM. I. GENERAL CONSIDERATIONS AND DENSITY DISTRIBUTION IN THE FILM. S.Franchetti.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1504-18 (Dec., 1956).

The change in free energy when an amount of helium is moved from the bulk liquid to the film is analysed and some of the terms in its expression are explicitly calculated. The dependence of the density in the film on the distance from the wall is studied, on the basis of the Van der Waals forces acting in the system. Two cases of experimental interest are numerically worked out. A.

536.48

2128. TENSILE STRENGTH OF LIQUID HELIUM II. J.W.Beams.
Phys. Rev., Vol. 104, No. 4, 880-2 (Nov. 15, 1956).

This was measured by the spinning capillary method and by a piston and cylinder method. The first method gave a tensile strength of 0.14 ± 0.02 atm and the second about half as much. These values are smaller than that expected from the present theories of the tensile strength of liquids. A.

536.48

2129. THE FLOW OF LIQUID HELIUM I THROUGH NARROW CHANNELS. D.C.Champeney.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1112-16 (Nov., 1956).

The nature of the flow of liquid He I through channels of about

1 micron diameter has been investigated between 2.19° K and 2.8° K using pressure heads of up to 3 cm of liquid. Previous measurements in wider channels showed a viscosity falling rapidly with decrease of temperature in this region, suggesting that in narrow channels non-classical flow might be detected even above the λ-point. The present experiments, however, show the flow to be purely classical. A.

536.48

2130. BOSE–EINSTEIN CONDENSATION AND LIQUID HELIUM. O.Penrose and L.Onsager.
Phys. Rev., Vol. 104, No. 3, 576-84 (Nov. 1, 1956).

The mathematical description of B.E. (Bose–Einstein) condensation is generalized so as to be applicable to a system of interacting particles. B.E. condensation is said to be present whenever the largest eignevalue of the one-particle reduced density matrix is an extensive rather than an intensive quantity. Some transformations facilitating the practical use of this definition are given. An argument based on first principles is given, indicating that liquid helium II in equilibrium shows B.E. condensation. For absolute zero, the argument is based on properties of the ground-state wave-function derived from the assumption that there is no "long-range configurational order". A crude estimate indicates that roughly 8% of the atoms are "condensed" (note that the fraction of condensed particles need not be identified with ρ_S/ρ). Conversely, it is shown why one would not expect B.E. condensation in a solid. For finite temperatures Feynman's theory of the lambda-transition is applied: Feynman's approximations are shown to imply that the criterion of B.E. condensation is satisfied below the lambda-transition but not above it. A.

536.48

2131. ON THE BOSE–EINSTEIN LIQUID MODEL FOR ^{3}He–^{4}He SOLUTIONS. B.K.Agarwal.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1345-7 (Dec., 1956).

It is shown that the assumption of a simple power law for the energy spectrum of He^3–He^4 solutions is capable of explaining the variation of the lambda-temperature with composition, and the variation of total vapour pressure as a function of temperature. P.T.Landsberg

536.48

2132. THEORY OF KINETIC PHENOMENA IN He II. I.M.Khalatnikov.
Uspekhi Fiz. Nauk, Vol. 59, No. 4, 673-753 (1956). In Russian.

This survey article touches on topics relating to the theory of He II. Pt I of the paper concerns the energy spectrum of He II, Pt II deals with the interaction of elementary excitations and Pt III with the kinetic coefficients of the two viscosities and of thermal conductivity in He II. 37 refs.(two-thirds of them Soviet work). C.R.S.Manders

536.48

2133. THE HYDRODYNAMICS OF He II. I.M.Khalatnikov.
Uspekhi fiz. Nauk, Vol. 60, No. 1, 69-160 (1956). In Russian.

This paper provides a survey under the main topics of: hydrodynamics of He II, hydrodynamics of solutions of extraneous particles in He II, explosions and sounds of large amplitude in He II, heat exchange between a solid body and He II. 40 refs. (one half Russian). See also preceding abstract. C.R.S.Manders

536.48

2134. DERIVATION OF THE FORMULA FOR THE ENERGY SPECTRUM OF LIQUID He^4. L.P.Pitaevskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 536-7 (1956). In Russian.

The formula obtained by Feynman (Abstr. 6569/1954), who used a special wave-function, is obtained by hydrodynamical techniques. G.E.Brown

536.48 : 532.612.4

SURFACE TENSION OF LIQUID He^3. See Abstr. 1947

536.48

2135. ROTATIONAL ATTENUATION OF SECOND SOUND IN HELIUM II. C.H.Blakewood, R.H.Walmsley and C.T.Lane.
Phys. Rev., Vol. 104, No. 6, 1495-6 (Dec. 15, 1956).

Second sound attenuation is measured, by a pulse technique, in the annulus between two concentric cylinders, the outer one of which is in motion and the inner one at rest. The results are compared with (a) previous measurements in which the inner cylinder moves and the outer one is at rest, and (b) an experiment due to Hall and Vinen in which helium is rotated in a bucket at constant velocity. A.

536.483

2136. SIMPLE EQUIPMENT FOR A SMALL LOW TEMPERATURE LABORATORY. R.F.Broom and A.C.Rose-Innes.
J. sci. Instrum., Vol. 33, No. 11, 420–4 (Nov., 1956).

Until recently low temperature research has been chiefly carried out in those laboratories having the complicated apparatus needed to liquify hydrogen or helium. It has now become possible to buy liquid helium and this paper describes simple and versatile low temperature equipment designed to use this helium. The temperature range in which experiments can be carried out is from 1.3 to 33° K. The paper is intended for those not already familiar with low temperature techniques. A.

536.483 : 538.24

2137. NUCLEAR COOLING. N.Kurti, F.N.H.Robinson, F.Simon and D.A.Spohr.
Nature (London), Vol. 178, 450-3 (Sept. 1, 1956).

The first successful nuclear demagnetization experiments are described, in which about ¾ g Cu in the form of fine wires has been cooled from about 10^{-2} °K to 2×10^{-5} °K; the magnetizing field was 28 kG and after demagnetization the Cu warmed up in a few minutes. From the results it is estimated that the temperature characterizing the nuclear interactions is 2.3×10^{-6} °K, which agrees in order of magnitude with theoretical prediction. D.Shoenberg

536.521

2138. TEMPERATURE MEASUREMENT AT HIGH PRESSURES BY THE EMISSION METHOD AND SOME OPTICAL PHENOMENA OCCURRING IN GASES UNDER THESE CONDITIONS. Ya.A.Kalashnikov and L.F.Vereshchagin.
Zh. tekh. Fiz., Vol. 26, No. 8, 1802-14 (1956). In Russian.

The method is based on the fact that, when part of emission spectrum is used for temperature measurement, the intensity of emission will vary as, at least, the 10-12th power of temperature. In the pyrometer described and illustrated the intensity of radiation was measured by means of a photocell. The high-pressure cylinder used was described in a previous paper (Abstr. 2126/1957). It was found photoelectrically (and confirmed visually) that the pyrometer readings depended to a great extent on the pressure, increasing as the pressure increased; it was concluded that optical investigations at high pressures and temperatures should be conducted so as to enable the beams to pass from the high-temperature region right to the exit from the high-pressure region over an isotropic solid in which density heterogeneity is eliminated. This was attained by means of a silica-rod light-conduit whose furnace (high temperature) end had a tight-fitting black iron cap. The temperature reading obtained with this contactless and lagless pyrometer depended only very little on pressure and agreed well with thermocouple readings. F.Lachman

536.587

2139. GOUY MODULATOR FOR THERMOCOUPLES. W.Primak.
Rev. sci. Instrum., Vol. 27, No. 10, 877 (Oct., 1956).

A circuit is described which, inserted in the thermocouple leads, converts the on/off control of a simple temperature controller into proportional control. It is pointed out that long-term drifts occur with this type of control owing to changes in the power requirement of the furnace. K.W.Plessner

536.62 : 536.653

2140. ISOTHERMAL CALORIMETER AND THE HEAT OF MIXING OF ISO-OCTANE-PERFLUOROHEPTANE SOLUTIONS. C.R.Mueller and H.E.Lewis.
J. chem. Phys., Vol. 25, No. 6, 1166-70 (Dec., 1956).

An isothermal calorimeter for measuring heats of mixing of binary solutions has been designed. The instrument utilizes twin calorimeters to eliminate troublesome corrections and a pair of differential thermistors for controlling the electrical circuit. There is no vapour space and the rate of mixing is controlled so that the heat absorbed is automatically compensated and the maximum temperature change is of the order of 0.001 to 0.002 deg C. This is accomplished by a differential bridge. The heats of mixing of perfluoroheptane and iso-octane were measured and the results compared with the values calculated from vapour pressure measurements. A.

536.628.2

2141. MODIFIED ADIABATIC CALORIMETER. M.W.Belaga, D.M.Coddington and H.Marcus.
Rev. sci. Instrum., Vol. 27, No. 11, 948-51 (Nov., 1956).

A modified adiabatic type calorimeter, capable of measuring the heat capacities of natural and synthetic organic liquids in the temperature range of 100° to 500° F, was designed, constructed, and

calibrated. In this calorimeter a fixed rate of power is supplied to the sample, and a bath which surrounds the sample container is maintained at the same temperature in order to prevent heat losses from the sample. The heat capacity of an unknown material may be calculated from measurements of the time rate of temperature rise, heat input, and mass of the sample. The calorimeter was calibrated with materials of known heat capacity and the following relation between the calorimeter constant and temperature was obtained:

$$K(T) = 0.256 - 3.706 \times 10^{-5}t + 6.839 \times 10^{-7}t^2$$ A.

536.631

2142. THE SPECIFIC HEATS OF CADMIUM AND MERCURY. P.L.Smith and N.M.Wolcott.
Phil. Mag. (Eighth Ser.), Vol. 1, 854-65 (Sept., 1956).

The specific heat of cadmium has been measured over the range 1.3°K to 20°K. The electronic term is found to be 1.5×10^{-4}T cal mole^{-1}deg^{-1} and the Debye θ at 0°K is 188°, in fair agreement with the value calculated from elastic constants. The specific heat of mercury has also been measured over the same range and is shown to be characterized by a sharply changing Debye θ with a minimum at 3°K. The lowest points measured have not reached a T^3 dependence of the lattice specific heat. A.

536.631

2143. THE HEAT CAPACITIES OF CHROMIUM AND NICKEL. J.A.Rayne and W.R.G.Kemp.
Phil. Mag. (Eighth Ser.), Vol. 1, 918-25 (Oct., 1956).

Heat capacity measurements have been made below 4.2°K on extremely pure specimens of chromium and nickel. In both cases the measurements give γ-values lower than those obtained by former observers. The values of Debye temperature also differ significantly from those of previous work, it being found that $\theta = 630$°K for chromium and $\theta = 440$°K for nickel in contrast to the older figures of 418°K and 413°K respectively. These new results help to resolve the apparently anomalous nature of the θ versus T curves for the two metals. The influence of the magnetic heat capacity on the results for nickel is also discussed. A.

537.312.62 : 536.631

SPECIFIC HEAT OF THE SUPERCONDUCTING STATE. See Abstr. 2144

536.631 : 537.312.62

2144. SPECIFIC HEAT OF THE SUPERCONDUCTING STATE. G.V.Chester.
Phys. Rev., Vol. 104, No. 4, 883-5 (Nov. 15, 1956).

A semiempirical argument is presented which shows that for tin the lattice specific heat of the normal state is also present in the superconducting state. This result follows from the law of similarity for the threshold field curves. It is also shown that the so called "electronic specific heat" of the superconducting state contains a large contribution from the motions of the ions in the lattice. A.

536.631

2145. HEAT CAPACITY OF TUNGSTEN BETWEEN 4 AND 15°K. T.R.Waite, R.S.Craig and W.E.Wallace.
Phys. Rev., Vol. 104, No. 5, 1240-1 (Dec. 1, 1956).

The results obtained can be represented by the equation: $C(\text{joules/mole deg}) = 1.11 \times 10^{-3}T + 1943(T/378)^3$, with an average deviation of about 1%. The electronic specific heat coefficient and the Debye θ are evaluated to be $(1.1 \pm 0.1) \times 10^{-3}$ joules/mole deg^2 and 378 ± 7°K, respectively. The results are compared with the theoretical calculations of Fine and of Manning and Choodorow and with measurements by other investigators in neighbouring temperature ranges. A.

536.633

2146. SPECIFIC HEATS OF FLUID ARGON NEAR THE CRITICAL POINT. G.O.Jones and P.A.Walker.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1348-50 (Dec., 1956).

It is reported that the specific heat of argon at constant pressure, when plotted against temperature, has sharp peaks near the critical point. If the temperature of the maximum is plotted as a function of pressure, an extrapolation of the vaporization curve is obtained. P.T.Landsberg

536.633 : 536.782

2147. ON THE JOULE–THOMSON EFFECT AND THE MOLAR HEAT CONTENT OF DEUTERIUM AND HELIUM. H.D.Baehr.
Z. Elektrochem., Vol. 60, No. 5, 515-17 (1956). In German.

The Joule–Thomson effect and the pressure dependence of the molar heat content of deuterium have been calculated in the temperature range 65-80°K and up to pressures of 180 atm, based on measurements by Johnston, Bezman, and Hood (Abstr. 1443/1947) of the integral cooling effect. Similarly, measurements by Zelmanov (Journal of Physics, Moscow, Vol. 3, 43, 1940) have been used for calculations of these effects for helium between 6 and 20°K and up to 20 atm. E.W.Kellermann

536.65

2148. THERMAL BEHAVIOR OF AMORPHOUS ICE. J.A.Ghormley.
J. chem. Phys., Vol. 25, No. 3, 599 (Sept., 1956).

Previous values for the heat of crystallization of amorphous ice at very low temperatures are very much lower than the values obtained in the experiments reported here. It is suggested that the difference between the heat of crystallization of amorphous ice at −120°C (15.8 cal/g) and the normal heat of fusion of ice at 0°C must represent the difference between the integral of heat capacity of supercooled water above the temperature of the glass transition and that of crystalline ice in the same temperature range. T.C.Toye

536.653 : 548.735.7

VARIATIONS IN HEAT OF SOLUTION OF MgO. See Abstr. 1758

THERMODYNAMICS 536.7/.8

536.712

2149. ON SUBSTITUTE PRESSURE IN THE ISOTHERMAL PROCESS. A.Krupkowski.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 1, 51-5 (1956).

A new concept of substitute pressure is defined in terms of the change in free energy in an isothermal process. Whilst the concept has similarities with that of fugacity it is unlike the latter in applying to all homogeneous substances in any state besides having a slightly different definition. Expressions for entropy, enthalpy and chemical potential are obtained in terms of the substitute pressure. F.E.Hoare

536.74

2150. NEGATIVE ABSOLUTE TEMPERATURES. M.J.Klein.
Phys. Rev., Vol. 104, No. 3, 589 (Nov. 1, 1956).

See Abstr. 6579 (1956). Ramsey's criteria for systems capable of negative absolute temperatures are justified. This is done by showing that a thermodynamic proof that the temperature must not be negative breaks down for systems satisfying Ramsey's conditions. A.

ELECTRICITY 537

537 : 534.21

2151. ON THE THEORY OF THE ACOUSTO-ELECTRIC EFFECT. A.van den Beukel.
Appl. sci. Res. B, Vol. 5, No. 6, 459-70 (1956).

The electric field, along the direction of propagation to which a travelling longitudinal acoustic wave passing through an insulated solid conductor gives rise, is calculated both for a metal and a semiconductor at temperatures greater than the Debye temperature. The field is found to be proportional to the acoustic intensity and the frequency of the wave. Numerical estimates show that in a rod of copper of reasonable length the resulting potential difference between the ends will be difficult to demonstrate experimentally on account of its small size, while for germanium it should be larger by several orders of magnitude. A.

537.123

2152. SEARCH FOR ANTIPROTONS. D.H.Stork, R.W.Birge, R.P.Haddock, L.T.Kerth, J.Sandweiss and M.N.Whitehead.
Phys. Rev., Vol. 105, No. 2, 729-30 (Jan. 15, 1957).

Two examples of antiproton annihilation have been observed in an emulsion stack exposed at the Bevatron. The experimental arrangement was designed to affect a partial separation of antiproton

and pion fluxes. From the yield of antiprotons, the total cross-section for antiprotons in beryllium is estimated to be $(1_{-0.1}^{+0.2})$ barn. The average energy of the antiprotons in the beryllium was 315 MeV. A.

ELECTROSTATICS. DIELECTRICS 537.2

537.213 : 518.5 : 621.317.729

2153. ELECTROLYTIC TANK, DESIGN AND APPLICATIONS. P.A.Kennedy and G.Kent.
Rev. sci. Instrum., Vol. 27, No. 11, 916-27 (Nov., 1956).

The theory of the electrolytic tank analogue as a device for the solution of potential problems is reviewed, and some of the more important applications are discussed. The mechanical requirements of an electrolytic tank design are stated. A description of the Harvard tank is given, indicating how these problems were met. The figure of mechanical uncertainty for the Harvard tank is estimated to be 0.01 in. A discussion of experimental error in tank measurements covers problems of electrode and electrolyte materials as well as difficulties resulting from surface tension. Control experiments for determining the accuracy of level and tilted tank measurements are described, and the results presented. Although high accuracy is possible in the level tank, only great care can produce results in the tilted tank which are reliable to within 3%. A.

537.22 : 538.652

2154. MAGNETOSTRICTIVE ELECTRICITY IN STRAIN GAUGES. I.Vigness.
Rev. sci. Instrum., Vol. 27, No. 12, 1012-14 (Dec., 1956).

Ferromagnetic wires, that have been suitably conditioned, generate electrical potentials when subjected to changes in elastic strain. Conditioning the wires involves alignment of the circumferential component of the magnetic field, due to domains in a preferred direction. This is accomplished by the magnetic field associated with a current passed through the wire. A disturbance which changes this established circumferential field causes a potential to appear between the ends of the wire. A.

537.226.1

2155. NEW EXPERIMENTS ON DIELECTRIC SATURATION IN POLAR LIQUIDS. A.Piekara and A.Chelkowski.
J. chem. Phys., Vol. 25, No. 4, 794-5 (Oct., 1956).

The Debye theory for polar gases predicts a decrease in permittivity at high electric fields. This has been observed with several polar liquids. This note reports an increase in permittivity for nitrobenzene, 1, 2-dichloroethane and 1,2-dibromoethane. This is explained by assuming that molecules tend to associate in antiparallel pairs; the field disturbs this arrangement and so causes an increase in average dipole moment. K.W.Plessner

537.226.1

2156. MOLECULAR THEORY OF THE DIELECTRIC CONSTANT OF NONPOLAR GASES. L.Jansen and A.D.Solem.
Phys. Rev., Vol. 104, No. 5, 1291-7 (Dec. 1, 1956).

A theory of molecular polarization is developed which applies to nonpolar gases consisting of axially symmetric molecules. The interaction Hamiltonian of the system includes induced dipole and induced and permanent quadrupole contributions. The average induced dipole moment of a molecule is evaluated through third order of perturbation theory, following earlier calculations for hydrogen and helium atoms by Jansen and Mazur. General equations are given for the induced dipole moment in terms of tensors $T^{(2)}$, $T^{(3)}$, $T^{(4)}$, characteristic for dipole–dipole, dipole–quadrupole, and quadrupole–quadrupole interactions, respectively; and characteristic functions C_1, C_2, ... C_7, depending upon the molecular charge distributions. It is shown that α in the Clausius–Mossotti equation is in general not equal to the polarizability of a free molecule, but depends on the density of the system. A.

537.226.1 : 537.311.1

2157. ON THE POSSIBILITY OF INTRODUCING AN EFFECTIVE DIELECTRIC CONSTANT AT HIGH FREQUENCIES. É.A.Kaner. and M.I.Kaganov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 459-61 (1956). In Russian.

It is shown that an effective dielectric constant $\epsilon_{eff} = (4\pi/cZ)^2$ can be introduced in the anomalous skin-effect region. A.

537.226.1

2158. THE GENERAL IMPORTANCE OF ION ADSORPTION IN INSULATING MATERIALS. P.Böning.
Z. angew. Phys., Vol. 8, No. 10, 516-20 (Oct., 1956). In German.

Reviews the experimental evidence for segregation of ions at phase boundaries during changes of state, and the resulting build-up of electric charges, including the following: the thermo-dielectric (Costa-Ribeiro) effect with various waxes, and the related effects in the freezing of water with concentrations of ionic impurities down to 10^{-7} N, together with the electret-forming capacity of several synthetic plastic materials. The discussion is mainly qualitative. F.F.Roberts

537.226.2

2159. THIOUREA, A NEW FERROELECTRIC. A.L.Solomon.
Phys. Rev., Vol. 104, No. 4, 1191 (Nov. 15, 1956).

With electrodes applied to (010) faces of the orthorhombic crystals, hysteresis loops and a dielectric constant anomaly have been observed below -104.8°C. The saturation polarization was 3.1 μcoulombs/cm^2 and the coercive field was less than 1 kV/cm. K.W.Plessner

537.226.1

2160. THE EFFECT OF UNILATERAL MECHANICAL PRESSURE ON THE PERMITTIVITY OF CERAMIC FERROELECTRICS. M.S.Lur'e and A.I.Medovoĭ.
Zh. tekh. Fiz., Vol. 26, No. 7, 1437-42 (1956). In Russian.

This was investigated in a region of low pressures. With weak a.c. fields the existence of a non-stationary relation between permittivity, ϵ, and pressure, p, is established for temperatures below the Curie temperature, $t < \theta$. This relation can be expressed by $(1/\epsilon)(\Delta\epsilon/\Delta p) = A_0 e^{-\alpha t}$, where A_0 and α are constants and A_0 is positive and independent of the sign of the pressure. For $t > \theta$ a stationary relation $\epsilon(p)$ occurs which is given by $(1/\epsilon)(\Delta\epsilon/\Delta p) = -A$. The non-stationary process becomes stationary with fields greater than some critical value. Then $(1/\epsilon)(\Delta\epsilon/\Delta p) = -A$ for $t \rightleftharpoons \theta$. The effect of polarization and application of an additional d.c. field modifies the relation $\epsilon(p)$ so that

$$\frac{1}{\epsilon}\frac{\Delta\epsilon}{\Delta p} = \begin{cases} +A \text{ for } t < \theta \\ -A \text{ for } t > \theta \end{cases}$$

which agrees with the thermodynamic theory of ferroelectrics for monocrystals. E.M.Dembinski

537.226.2

2161. DIELECTRIC CONSTANT OF BARIUM ORTHOSILICATE. C.P.Hadley, H.W.Kraner and M.R.Royce.
J. appl. Phys., Vol. 27, No. 11, 1384-5 (Nov., 1956).

This has been determined over a range of apparent densities for compressed-powder tablets. The permittivity of the solid phase was obtained by matching to the permittivity of a liquid. Using the value for 50% porosity (4.2), and the measured capacitance, the thickness of the interface layer of an oxide-coated cathode is calculated as 2.10^{-5} cm. K.W.Plessner

537.226.2

2162. MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. XIII. THE CRITICAL WAVELENGTHS OF SOME ALIPHATIC ETHERS AND LONG-CHAIN KETONES. G.B.Rathmann, A.J.Curtis, P.L.McGeer and C.P.Smyth.
J. chem. Phys., Vol. 25, No. 3, 413-16 (Sept., 1956).

For previous part, see Abstr. 4332 (1952). The dielectric constants and losses of ethyl ether, n-decyl ether, n-heptanone-2, n-pentadecanone-8, n-heptadecanone-9, and benzophenone, and of solutions of benzophenone in heptane and in a 50-50 mixture of heptane and benzene have been measured at wavelengths of 1.25, 3.22 and 10.0 cm at temperatures between 4 and 85°. The arc plots constructed from these data and the measured low-frequency dielectric constants have been used to calculate the critical wavelengths at which the loss is a maximum. Several molecules of similar sizes and shapes are shown to possess similar viscosities and critical wavelengths. For the pure polar liquids, a rough proportionality between the critical wavelengths or dielectric relaxation times and the viscosities is observed. A.

537.226.2

2163. DIELECTRIC PROPERTIES OF WOOL–WATER SYSTEMS. II. 26 000 MEGACYCLES. J.J.Windle and T.M.Shaw.
J. chem. Phys., Vol. 25, No. 3, 435-9 (Sept., 1956).

For previous part, see Abstr. 278 (1955). The complex dielectric constant for wool–water systems has been determined at a frequency of 26 000 Mc/s by a cavity resonator method similar to the method employed at 3000 and 9300 Mc/s. At 26 000 Mc/s, measurements

on single wool fibres and at relative humidities as high as 98% have proved feasible. The complex dielectric constant of the wool–water system increases with increasing water content. Curves for the dielectric constant and loss factor of the wool–water systems at 26 000 Mc/s are presented and analysed in terms of a new theory of water sorption by wool. According to this theory, which is based upon a theory originally proposed by Cassie, the water sorbed by wool consists of three distinct molecular species: (1) localized water irrotationally bound to polar sites in the wool, (2) mobile water with bulk liquid properties, and (3) intermediate water with a potential energy of absorption which lies between those for localized and mobile water. The analysis of the measurements at 26 000 Mc/s for the higher relative humidities in terms of this theory has resulted in a more thorough description of the properties of the sorbed water than was possible for the data obtained at 3000 and 9300 Mc/s. A.

537.226.2

2164. INFLUENCE OF DOPING WITH SMALL TRACES OF IMPURITY (1 IN 10^5 OF Cu) ON THE DEBYE DIPOLE ABSORPTION OF ZINC OXIDE. B.Hagene, H.Corneteau and M.L.Blanchard.
J. Phys. Radium, Vol. 17, No. 5, 450-1 (May, 1956).. In French.

The absorption bands can be completely modified by the doping. The peak in the curve relating complex permittivity, measured at 10 kc/s, and temperature moves to higher temperatures as the amount of added Cu is increased from 10^{-7} to 10^{-3}; the most intense band is observed for 1 in 10^5 parts of Cu. C.A.Hogarth

537.226.2

2165. ON THE OBSERVATION AT VERY LOW TEMPERATURES OF A DEBYE DIPOLE ABSORPTION BAND IN ZINC OXIDE. (ACTIVATION ENERGY OF ORDER 0.05 eV.) M.L.Blanchard, J.Le Bot and H.Corneteau.
J. Phys. Radium, Vol. 17, No. 5, 451 (May, 1956). In French.

Two specimens of pure ZnO and others doped with traces of Cu were measured at frequencies from 1 to 1000 kc/s and over the temperature range 4 to 273° K. The pure specimens show the characteristic absorption bands at about 100° K depending on frequency. At 30-50° K a new set of bands appear for the pure samples but these are absent for the doped ones. The derived activation energies for these bands are of order 0.05 eV, and thus the absorption may arise from impurities or defects in the crystal, of the kind that produce electrical conductivity. C.A.Hogarth

537.226.2

2166. THE INFLUENCE ON ELECTRIC STRENGTH OF MECHANICAL DEFORMATION CAUSED BY APPLICATION OF VOLTAGE TO POTASSIUM CHLORIDE CRYSTALS. R.Cooper and A.A.Wallace.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1287-92 (Dec., 1956).

When electric fields of about 10^6 V cm^{-1} are applied to solid dielectrics the mechanical pressures developed between the electrodes are considerable. The manner in which this mechanical pressure may have influenced the measurements must be considered when interpreting experimental investigations of intrinsic electric strength. With many potassium chloride crystals it is shown that deformation of the crystal structure may be caused by application of the voltage before electrical breakdown takes place. The result of this is to increase appreciably the electric strengths relative to the values obtained from undeformed specimens. Information is given in the paper about the magnitude of the electric field in which structural deformation first takes place and about the subsequent behaviour of specimens in which structural defects have been introduced by the application of electric fields. A.

537.226.2

2167. INVESTIGATION OF THE DIELECTRIC POLARIZATION AND THE LOSSES OF POLYTRIFLUOROCHLOROETHYLENE. G.P.Mikhaĭlov and B.I.Sazhin.
Zh. tekh. Fiz., Vol. 26, No. 8, 1723-9 (1956). In Russian.

Investigations conducted in the frequency range 50-10^7 c/s and in the temperature range from −100 to +230° C have shown that this plastic material is characterized by two regions of dielectric losses of relaxation nature. The value of ϵ is 2.6 −3.8, that of tan δ for "high-frequency relaxation" (low temperature, −30 to +200° C) losses is 2-6 x 10^{-2}. Dielectric losses in the "medium-frequency" (high-temperature) relaxation are greater for a hardened (rapidly cooled) than for annealed (slowly cooled) plastic material, and their maximum occurs at lower temperatures. The losses are greater for the hardened specimens at "high-frequency" relaxation, too. The $\rho_V/(1/T)$ curve shows a kink at 80-85° C. Both types of relaxation polarization are caused by the polarity of the polymer molecule; this is also borne out by the tests of mechanical properties.

F.Lachman

537.226.2

2168. DIELECTRIC STRENGTH OF THIN LAYERS OF ALUMINIUM OXIDE. S.N.Koĭkov and A.N.Tsikin.
Zh. tekh. Fiz., Vol. 26, No. 10, 2248-53 (1956). In Russian.

By careful heating specimens are given an oxide coating, the breakdown strength of which is high and steady. Relations between breakdown voltage, layer thickness and electrode polarity for layers 10-180 μ thick show that breakdown under normal atmospheric conditions is due to breakdown of air in pores. In vacuo, there are three breakdown mechanisms, viz. breakdown of the grains of aluminium oxide or of vacuum in pores, or flashover of walls of pores.

Electrical Research Association

537.226.2 : 548.7

2169. EFFECT OF DISRUPTIONS OF THE CRYSTAL LATTICE ON THE DIELECTRIC CONSTANT OF ROCKSALT CRYSTALS. Yu.A.Sikorskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 11, 2487-92 (1956). In Russian.

Annealing reduces the value of ϵ of the crystals, this being probably attributable to a variation of the internal stresses in the lattice. The presence of colloidal colour centres increases the value of ϵ. There are theoretical reasons for regarding these colloidal centres as metal colloids interspersed in the crystal lattice. The presence of atomic colour centres, obtained by various methods, was not found to alter the value of ϵ within the accuracy of the measurements. Electrical Research Association

537.226.2

2170. FERROELECTRICITY OF GLYCINE SULFATE. B.T.Matthias, C.E.Miller and J.P.Remeika.
Phys. Rev., Vol. 104, No. 3, 849-50 (Nov. 1, 1956).

The substance $(CH_2NH_2COOH)_2.H_2SO_4$ and its isomorphous selenate were found to be ferroelectric with respective Curie points 47° and 22° C. For the sulphate the room temperature spontaneous polarization is 2.2 x 10^{-6} C cm^{-2} and the coercivity 220 V cm^{-1}.

E.P.Wohlfarth

537.226.2

2171. THE DIELECTRIC PROPERTIES OF BARIUM TITANATE CERAMICS. G.Mesnard and L.Eyraud.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 62 A- 77 A (June, 1956). In French.

Measurements have been made of the spontaneous polarization, remanent polarization, coercive field, and dielectric constant of ceramic $BaTiO_3$ capacitors, for 50 c/s fields, over the temperature range −150° C to + 200° C. The results are explained by considering the effect of changes in the ferroelectric domain structure of the randomly oriented crystallites of the ceramic. L.E.Cross

537.226.2

2172. ON THE HYSTERESIS CYCLES OF BARIUM TITANATE CERAMICS. G.Mesnard and L.Eyraud.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 78 A - 80 A (June, 1956). In French.

A more rigorous calculation is given of the spontaneous polarization of ceramic $BaTiO_3$ using the basic assumptions outlined in a previous paper (see preceding abstract). L.E.Cross

537.226.2

2173. MOBILITY OF THE SPONTANEOUS POLARIZATION IN FERROELECTRIC BARIUM TITANATE. L.Eyraud.
J. Phys. Radium, Vol. 17, No. 6, 25S-27S (June, 1956). In French.

The spontaneous polarization of ceramic $BaTiO_3$ is calculated on the assumption that the polarizations of the individual crystallites may take up possible polar directions nearest to the direction of the applied electric field. There is a qualitative agreement between calculated and experimental values in the orthorhombic and rhombohedral forms. In the tetragonal state, the low experimental value suggests that the mobility of the spontaneous polarization is limited by the smaller number of possible polar directions and by the high electrostriction. L.E.Cross

537.226.2 : 621.315.612

2174. INVESTIGATIONS CONCERNING POLARIZATION IN BARIUM TITANATE CERAMICS. G.W.Marks, D.L.Waidelich and L.A.Monson.
Trans Amer. Inst. Elect. Engrs I, Vol. 75, 469-77 (1956) = Commun. and Electronics, No. 26 (Sept., 1956).

It is shown that both symmetrical and unsymmetrical hysteresis

loops, the latter being characteristic of polarized specimens, can be represented best by a Fourier series. It was found that direct voltage and even harmonic components are present in the unsymmetrical loops. The percentage second harmonic and the electromechanical coupling coefficient both rise with increasing depolarizing voltage and reach a maximum value at approximately 15 000 V/cm. The measurement of the second harmonic is possible even when the activity is so small that measurement of the coupling coefficient becomes very inaccurate or impossible. The addition of calcium titanate in small percentages markedly raises the coercive force but lowers the spontaneous and remanent polarization in the range from 0 to 80° C. However, it does not have marked effect between the latter temperature and the Curie point. It was found from studies of the discharge currents on depolarizing specimens by sudden immersion in hot oil that the polarization observed from the discharge curves is essentially the same as the remanent polarization determined from oscillograms of saturated hysteresis loops. A.

537.226.2 : 621.315.612.4

2175. AGEING OF THE DIELECTRIC PROPERTIES OF BARIUM TITANATE CERAMICS. K.W.Plessner.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1261-8 (Dec., 1956).

The permittivity and power factor of ceramic barium titanate and barium titanate solid solutions have been measured as a function of time, starting from the time of cooling the material through the Curie point. Both parameters decrease linearly with log t over periods extending to several years. A theory is proposed which postulates that a large contribution is made to the permittivity by the motion of domain walls, and that the domain walls are gradually moved to more stable and less polarizable states by thermal agitation. A wide distribution of activation energies, reflecting the random character of obstacles to domain wall motion in a ceramic, yields the log t law. Domain walls moving over low-energy humps are considered responsible for the power factor decay. A.

537.226.2

2176. CONTRIBUTION TO THE THERMODYNAMICAL THEORY OF THE FERROELECTRIC PROPERTIES OF BARIUM TITANATE. L.P.Kholodenko.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 244-53 (1956). In Russian.

The nature of the phase transition from the non-ferroelectric to ferroelectric phase is discussed. The effect of an electric field on the temperature of the phase transition is considered. It is shown that in the case of a phase transition of the first kind a shift of the transformation point takes place and the magnitude of this shift has been computed. The temperature dependence of the dielectric constant for phase transitions of the second kind has been determined. It is shown that for transitions of this kind an "induced piezoelectric effect" should appear when the electric field is turned on. The "induced piezomodules" have been computed. A.

537.226.2

2177. DIELECTRIC PROPERTIES OF BISMUTH TITANATES. G.I.Skanavi and A.I.Demeshina.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 565-8 (1956). In Russian.

It is shown that bismuth titanates possess a large dielectric constant (ϵ = 70-120) and a comparatively large positive temperature coefficient (130-550 x 10^{-6}), a fact which apparently can be attributed to the combination of a favourable internal field and a high ionic polarizability. The process of formation of one of the bismuth titanates has been investigated and the temperature and frequency dependences of ϵ and tan δ for various bismuth polytitanates have been measured. A.

537.226.2

2178. BEHAVIOUR OF FERROELECTRICS IN STRONG ELECTRIC FIELDS. V.A.Bokov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1902-11 (1956). In Russian.

Barium titanate and six ferroelectric solid solutions were investigated in electric fields of frequency 70 c/s. It is shown that the coefficient of non-linear distortion of current passing through a ferroelectric capacitor increases with increasing field intensity, and the softer the ferroelectric composition, the greater is the rate of increase. In sufficiently strong electric fields, the coefficient of non-linear distortion can exceed 100%. In regions of low-temperature phase transitions temperature dependences of permittivity (ϵ_1), of different compositions show peaks in fields of the order of 1-3 kV/cm. As the field is increased these peaks, including that in the region of the Curie point, are somewhat flattened and their maxima are displaced to lower temperatures. In strong electric fields the maximum of permittivity does not correspond to the phase transition point. Of all the investigated solid solutions the samples of $Ba(Ti_{0.9}, Sn_{0.1})O_3$ and $Ba(Ti_{0.9}, Zr_{0.1})O_3$ show the greatest non-linearity, $N = (1/\epsilon)(d\epsilon_1/dE_{\parallel})$, at room temperature. Z.Krasucki

537.226.3 : 548.7

2179. MECHANISM OF DIELECTRIC RELAXATION LOSSES IN CRYSTALS WITH POLAR MOLECULES. I.Ts.Lyast.
Zh. tekh. Fiz., Vol. 26, No. 10, 2293-301 (1956). In Russian.

The dielectric relaxation losses in crystals with polar molecules are associated with transitions of the polar molecules into unoccupied positions. These transitions are, generally speaking, accompanied by rotations of the polar molecules, these producing relaxation polarization of the crystal. The complex dielectric constant is found by solving the kinetic equation for the transistions of the polar molecules. A comparison with experimental results refers to the case of gypsum. Electrical Research Association

537.226.31

2180. DIELECTRIC LOSSES IN ALKALI HALIDE CRYSTALS AT HIGH FREQUENCY. A.A.Vorob'ev and K.A.Vodop'yanov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 429-32 (1954). In Russian.

Dependences of tanδ at 1 Mc/s on activation energy, lattice energy, lattice constant, heat of formation, and heat of sublimation are considered for crystals of NaCl, KCl, KBr and KI. It is concluded, that the dielectric losses in alkali halide crystals depend on chemical composition and stability of chemical combination, and that admixtures play only a secondary role. Explanation of the mechanism of the dielectric losses is given. Investigation of tanδ in solid solutions of isomorphic crystals KI–KBr shows, that, as expected, their dielectric losses are greater than the losses in KI and KBr. Z.Krasucki

537.226.31

2181. DIELECTRIC LOSSES IN GLASSES. II. INVESTIGATION OF THE ELECTRICAL AND PHYSICAL PROPERTIES OF ALUMINA–SODIUM GLASSES. N.M.Verebeĭchik and V.I.Odelevskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 8, 1696-703 (1956). In Russian.

For Pt I see Abstr. 8165 (1952). Investigation of dielectric losses, electrical conductivity, thermal expansion and refractive index of glasses corresponding to the molecular formula $Na_2O \cdot x Al_2O_3 \cdot (17 - 2x) SiO_2$. It is shown that for the values of $x = 1 \pm 0.2$ the following variables pass simultaneously through their maxima: dielectric loss, conductivity, specific volume and thermal expansion. This confirms the result obtained previously with alumina–potassium glasses, that small changes in the oxygen number b = O/(Si + Al) have an important influence on the properties of glasses with high SiO_2 content. E.M.Dembinski

537.226.31

2182. DIELECTRIC LOSSES IN GLASSES. III. RELAXATION "HIGH-TEMPERATURE" DIELECTRIC LOSSES IN ALKALINE GLASSES. N.M.Verebeĭchik and V.I.Odelevskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 8, 1704-13 (1956). In Russian.

A critical review of existing theories on the subject. A structural model of the alkaline alumina–containing glass with permanent mobile dipoles is examined. Temperature dependences of dielectric losses in high-silica-content alumina–sodium glasses are investigated in the region of high values of tan δ. It is shown that, in conformity with the theory, there exist in these glasses sharply pronounced relaxation temperature maxima of tan δ and high values of permittivity at temperatures of the order of 100-150° C. Also temperature dependence of tan δ of the alkaline window glass is investigated at various frequencies and the existence of relaxation maxima of tan δ is shown. E.M.Dembinski

537.226.31

2183. NATURE OF TEMPERATURE DEPENDENCE OF DIELECTRIC LOSSES IN POLARIZATION OF IONIC COMPOUNDS. N.P.Bogoroditskiĭ and I.D.Fridberg.
Zh. tekh. Fiz., Vol. 26, No. 9, 1884-9 (1956). In Russian.

Simple borate glasses, silicate glasses and some ceramic materials were investigated at 1 x 10^6 c/s. In contrast with some published data, all these substances show dependence of tan δ on temperature. In the range 0° C to 300° C, tan δ of borate glasses increases with temperature. Tan δ of silicate glasses, investigated between –150° C and +300° C, passes through a minimum. The authors conclude that dielectric losses can be reduced basically to the following physical processes: (i) phenomena of relaxation, dependent on thermal motion of particles; (ii) phenomenon of ionization of a substance (usually a gas) developing in a field of high intensity. Z.Krasucki

537.226.33

2184. PROTON JUMPS AND THE ELECTRICAL BEHAVIOR OF ICE AND ICE–NH_4F SOLUTIONS. S.Zaromb.
J. chem. Phys., Vol. 25, No. 2, 350-6 (Aug., 1956).

Previous suggestions that dielectric relaxation in ice may occur by means of proton shifts have been refuted by Bjerrum (Abstr. 4747/1952). Yet, the role of ions in this relaxation process cannot be ignored in view of the more recent studies on ice–NH_4F solutions, which indicate that solute ions can accelerate the rotation of ice molecules at a distance of 30 A or more from any ion. Simple electrostatic calculations show that proton jumps in ice would entail the formation of "Bjerrum fault sites". In the case of pure ice, this might explain why: (a) the proton jump conductivity is much lower than in water at 0° C; and (b) the concentration of fault sites seems to be rather high, according to Bjerrum. Estimates of the frequencies of proton jumps and of activation energies show no disagreement of the proposed explanations with known facts. In the case of ice–NH_4F solutions, proton jumps occurring between second-neighbour ion pairs, $F^- – H_2O – NH_4^+$, may also induce fault sites at the neighbouring molecules. This ion-pair mechanism would agree with the low activation energy for these rates and with the peculiar concentration dependence of the frequency factor. Finally, the thickness of the ion atmosphere should, at equilibrium, be less in ice–NH_4F solutions than in aqueous solutions of the same concentration. This, together with the above, might account for the changes with time in the dielectric relaxation rates of concentrated ice-NH_4F solutions observed immediately after freezing. A.

537.226.8

2185. ANOMALOUS POLARIZATION IN POLYCRYSTALLINE TITANIUM DIOXIDE. N.P.Bogoroditskiĭ, I.D.Fridberg and N.M.Tsvetkov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1890-901 (1956). In Russian.

Specially purified titanium dioxide, tested in the range of temperature from −200° C to +300° C and at frequencies from 2×10^3 c/s to 1 Mc/s, has no anomalous electric characteristics. Anomalous polarization is observed, however, in titanium dioxide containing admixtures of Nb_2O_5 and CaO. Addition of Al_2O_3, Fe_2O_3 and ZrO_2 removes the anomalies. Anomalous polarization is also observed in pure titanium dioxide heat-treated to pale blue colour in a reducing atmosphere. The anomalies are observed at audio frequencies; in the region of radio frequencies, tan δ decreases for all compositions. X-ray analysis of titanium dioxide with admixtures of foreign oxides (CaO, BaO) shows a normally shaped crystal lattice of rutile. In the region of sufficiently large concentrations of admixtures of Fe_2O_3, Nb_2O_5 and Al_2O_3 the presence of single-phase rutile is found. A solid solution is manifested clearly in presence of Nb_2O_5 admixtures. The most probable mechanism of dielectric losses appears to be an electron relaxation mechanism depending on partial reduction of TiO_2. Z.Krasucki

ELECTRIC CONDUCTION. CURRENTS 537.3

537.311.31 : 535.393

2186. ELECTRICAL RESISTANCE AND TRANSPARENCY OF FILMS OF ALLOYS OF Mg–Sb, Mg–Bi, Mg–Sn. G.A.Kurov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 2, 207-8 (1954). In Russian.

A thin alloy film, of composition varying from 100 per cent concentration of one metal to 100 per cent concentration of another, shows in its central part a narrow strip which is transparent in transmitted light. Electrical resistance of the film has a maximum in the transparent region. Photometric curves for the samples are similar to the curves of electrical resistance. Exposure to air improves the transparency of the strip, makes it wider and increases its resistance. It is concluded, that the composition of the film in the transparent section corresponds to compounds Mg_3Sb_2, Mg_3Bi_2, Mg_2Sn.
Z.Krasucki

537.311.31 : 538.632

2187. HALL COEFFICIENT AND RESISTIVITY OF α- AND β-BRASS FROM 20-600° C. V.Frank.
K. Danske Vidensk. Selsk., mat.-fys. Medd., Vol. 30, Paper 4, 12 pp. (1955).

The Hall coefficients and resistivities of Cu–Zn alloys in the α- and β-range have been determined by an a.c. method. The observed resistivities are in agreement with earlier results. The sign of the Hall coefficient is normal for all specimens investigated; in the α-range, R_H decreases with increasing Zn content more rapidly than predicted by free electron theory and shows a strong temperature dependence for the Zn-rich alloys. For β-brass, R_H is practically proportional to the resistivity for various temperatures including the temperature range of the order-disorder transition. Some implications of the results for the band structure of these alloys are suggested. A.

537.311.31 : 537.323 : 536.212.2

2188. ELECTRICAL PROPERTIES OF ALLOYS OF THE SYSTEMS NiTe–$NiTe_2$. V.P.Zhuze and A.R.Regel'.
Zh. tekh. Fiz., Vol. 25, No. 6, 978-83 (1955). In Russian.

Homogeneous specimens were obtained by direct fusion with subsequent prolonged annealing, or by sintering under pressure. Maxima in thermal and electrical conductivity, and minima in thermoelectric power were observed at NiTe and $NiTe_2$. The temperature coefficient of resistivity in the range 20-300° C was always metallic. It was concluded that bonding in the system was predominantly metallic though measurements on $NiTe_2$ single crystals might show it to have semiconducting properties. Preliminary measurements on $CoTe_2$ showed that it resembled $NiTe_2$. C.H.L.Goodman

537.311.31 : 536.212.6

THERMAL AND ELECTRICAL CONDUCTIVITY OF LITHIUM AT LOW TEMPERATURES. See Abstr. 2113

537.311.32

2189. A NEW ELECTRODE SYSTEM FOR THE DETERMINATION OF THE VOLUME RESISTIVITY OF INSULATING MATERIALS. R.Lacoste.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1609-11 (Nov. 19, 1956). In French.

Brief description of the use of evaporated metal electrodes. Their use ensures good contacts on very thin specimens or rough surfaces. I.D.L.Ball

537.311.32

2190. CYCLOTRON RESONANCE EFFECTS IN GRAPHITE. J.K.Galt, W.A.Yager and H.W.Dail, Jr.
Phys. Rev., Vol. 103, No. 5, 1586-7 (Sept. 1, 1957).

Reports preliminary measurements at temperatures of 77, 4.2, 1.3 and 1.1° K at a frequency of 24 kMc/s and with magnetic fields up to 8000 oersted. The results were similar to those obtained previously for Bi. C.A.Hogarth

537.311.33 : 538.639

2191. PHENOMENON OF THE NEGATIVE MAGNETORESISTANCE IN SEMICONDUCTORS. C.Rigaux and J.M.Thuillier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2710-12 (June 4, 1956). In French.

A change of sign of the magnetoresistance with increasing field is observed for InSb. This effect is explained in terms of splitting of the electron energy levels with increasing magnetic field.
C.A.Hogarth

537.311.33 : 621.314.63

2192. MINORITY-CARRIER STORAGE IN SEMI-CONDUCTOR DIODES. J.C.Henderson and J.R.Tillman.
Proc. Instn Elect. Engrs, Paper 2293 R, publ. Jan., 1957, 16 pp. To be republished in Vol. 104 B (1957).

Hole storage is an effect which takes place in semiconductor diodes using n-type base material; it has a counterpart in electron storage in p-type material. It gives rise to several electrical effects, particularly to transient reverse currents in diodes on the application of a reverse bias. The effects are deduced, quantitatively, by solving the continuity equation with boundary conditions appropriate to the geometry and the external circuit. Planar and hemispherical diodes are analysed separately, although the former is only a special case of the latter. Parts of the analyses assume a reverse voltage to be applied immediately following the passage of forward current; another part assumes delay and calculates the decay of floating potential which results. Both significant and negligible limiting of the transient reverse current, by the external circuit, are considered. The analyses are tested by experiments, particularly some using modulation techniques, and used to deduce the hole lifetime in the base material of experimental diodes. Fair agreement is recorded between methods based on measurements of (a) the decay of current at short and at long times after the application of reverse bias, (b) the duration of limiting, and (c) the decay of floating potential. The extent to which the analyses apply to point-contact diodes remains debatable, in view of Waltz's observations [see Abstr. 427B/1953; Proc. Inst. Radio Engrs, Vol. 40, 1483-7 (Nov., 1952)] and the difficulty of obtaining quantitative confirmation with commercial diodes. A.

537.311.33 : 535.37

2193. SEMICONDUCTORS AND PHOSPHORS; INTERNATIONAL COLLOQUIUM. P.T.Landsberg.
Nature (London), Vol. 178, 1156-8 (Nov. 24, 1956).

This colloquium was held at Garmisch (Germany) in August 1956 with the support of the International Union of Pure and Applied Physics. Ninety papers were presented.

537.311.33

2194. RECOMBINATION OF ELECTRONS AND HOLES AT DISLOCATIONS. S.R.Morrison.
Phys. Rev., Vol. 104, No. 3, 619-23 (Nov. 1, 1956).

The phenomenon of hole—electron recombination at dislocations is examined, and it is demonstrated that the space charge barrier surrounding the dislocation may have a dominant effect in determining the characteristics of recombination. In particular, the inclusion of the space charge effect leads directly to the slow decay phenomena observed in silicon and n-type germanium. The characteristics of electrical fluctuations due to trapping at these levels are discussed on the basis of the model. A.

537.311.33 : 538.63

2195. LONGITUDINAL MAGNETORESISTANCE IN THE QUANTUM LIMIT. P.N.Argyres and E.N.Adams.
Phys. Rev., Vol. 104, No. 4, 900-8 (Nov. 15, 1956).

A study has been made of the effect of a magnetic field on the scattering of electrons in a semiconductor with spherical energy surfaces. The theory has been applied to longitudinal magnetoresistance in the case of a very large magnetic field and low temperatures so that all conduction electrons are in the ground oscillator state. Relaxation times for phonon and ionized impurity scattering have been calculated and the corresponding mobilities for a degenerate and nondegenerate semiconductor have been derived. Contrary to the zero magnetoresistance predicted by the usual Boltzmann theory, a field-dependent magnetoresistance is found. For a nondegenerate semiconductor and in the ionized impurity scattering range a negative magnetoresistance is predicted. A.

537.311.33 : 537.32

2196. THEORY OF TRANSPORT EFFECTS IN SEMICONDUCTORS: THERMOELECTRICITY. P.J.Price.
Phys. Rev., Vol. 104, No. 5, 1223-39 (Dec. 1, 1956).

The phenomenological theory of the thermoelectric effects in a cubic or isotropic electronic conductor is developed. It is shown that, as a consequence of the appropriate Onsager relation, the "gauge" adopted here for the thermoelectric coefficients of a single substance is such that the second Kelvin relation takes a specially simple form for a single substance. The general formulae obtained are applied to the theory of thermoelectricity in a two-band semiconductor, and the formulae for the thermoelectric power stated in a previous paper (Abstr. 5859/1956) are derived. The Onsager principle leads to a general relation between two phenomenological transport parameters for a single carrier band, one (γ) measuring the ratio of thermodiffusion coefficient to drift mobility, the other (δ) specifying the thermal energy transported with the current due to an electric field. The modification of these results needed to take account of the variation of band-edge energies with temperature is discussed. The evaluation of thermoelectric data for mixed semiconductors, on the basis of the present results, is discussed: some experimental data for germanium are analysed from the point of view arrived at. The effect of a strong magnetic field, and the effect of strain, on the thermoelectric power are treated. It is pointed out that shear strain should change the activation energy for an impurity binding a carrier in a "many-valley" band, by decoupling the orbitals associated with different valleys and interacting through the chemical shift effect, and that this change should, among other consequences, appreciably change the thermoelectric power at very low temperatures. Exact formulae for this decoupling effect are obtained for donors in germanium. A.

537.311.33 : 539.217

2197. RATE LIMITATION AT THE SURFACE FOR IMPURITY DIFFUSION IN SEMICONDUCTORS. F.M.Smits and R.C.Miller.
Phys. Rev., Vol. 104, No. 5, 1242-5 (Dec. 1, 1956).

When a rate limitation exists at the surface for impurity diffusion in semiconductors, the appropriate boundary condition is equivalent to the radiation boundary condition for the conductance of heat in solids. The intentional introduction of an additional external rate limitation allows the measurement of partition coefficients. Solutions to the diffusion equation are summarized and the resulting impurity distributions are discussed. A.

537.311.33

2198. CLASSICAL BOLTZMANN THEORY OF CYCLOTRON RESONANCE FOR WARPED SURFACES. H.J.Zeiger, B.Lax and R.N.Dexter.
Phys. Rev., Vol. 105, No. 2, 495-501 (Jan. 15, 1957).

A classical Boltzmann model of cyclotron resonance with an energy-independent collision time is developed. An approximate solution of the Boltzmann equation is obtained by expanding the perturbed distribution function $\Phi(p,\Theta,\phi)$, in a Fourier series in ϕ, where the spherical coordinates are defined with the polar axis along the magnetic field direction. The solution yields a fundamental cyclotron resonance absorption line, which shows line shape anisotropy, as well as a shift in resonance peak with magnetic field direction. The theory also indicates resonance absorption at harmonics of the fundamental cyclotron resonance frequency, due to the warping of the constant-energy surfaces. The results are applied to a calculation of line shapes and harmonic intensities for heavy holes in silicon and germanium. A.

537.311.33

2199. THE HALL EFFECT IN SEMICONDUCTORS. R.Mansfield.
Proc. Phys. Soc. B, Vol. 69, Pt 8, 862-5 (Aug., 1956).

The approximations involved in formulae for the Hall constant of nondegenerate semiconductors are critically examined. The cases of impurity scattering and of combined impurity and lattice scattering are considered. J.B.Birks

537.311.33

2200. PLASMA INTERACTION AND CONDUCTION IN SEMICONDUCTORS. H.Fröhlich and S.Doniach.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 961 (Sept., 1956).

It is pointed out that in semiconductors the conditions in which plasma waves influence the scattering of charge carriers should often hold. This would alter the $T^{-\frac{3}{2}}$ law for mobility due to lattice scattering. K.W.Plessner

537.311.33

2201. THE STATISTICS OF CHARGE CARRIER FLUCTUATIONS IN SEMICONDUCTORS. R.E.Burgess.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 1020-7 (Oct., 1956).

The statistical fluctuations in the number of charge carriers (conduction electrons or valence band holes) in a given volume of semiconductor in the steady state is calculated from the transition probabilities of electrons between the conduction and valence bands or between either band and impurity levels. The case in which one independent fluctuating variable (either n or p) specifies the electronic state of the system is considered. Simple general formulae are developed for the mean value n_0 of n and its variance and it is shown that for large numbers n tends to be normally distributed about n_0. The relaxation time for small deviations from equilibrium is evaluated. These results are applied to three cases: (i) the intrinsic semiconductor, (ii) the strongly extrinsic semiconductor and (iii) the slightly extrinsic semiconductor with all impurity atoms ionized. The relation between the statistical approach and the thermodynamical treatment is indicated. A.

537.311.33

2202. ANISOTROPIC GALVANOMAGNETIC EFFECTS IN SEMICONDUCTORS. J.R.Drabble and R.Wolfe.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1101-8 (Nov., 1956).

The "many-valley" theory of the galvanomagnetic effects in cubic semiconductors proposed by Abeles and Meiboom is extended to include semiconductors belonging to any crystal class. The theory is applied to the crystal class $\bar{3}$ m. Explicit expressions for the components of the conductivity, Hall conductivity and magnetoconductivity tensors are derived for a six-valley model in which the energy extrema lie on the reflection planes in k-space. These expressions are consistent with preliminary measurements on a single crystal of n-type bismuth telluride in which all the galvanomagnetic effects are anisotropic. A.

537.311.33

2203. STATISTICS OF ELECTRONS AND HOLES IN A HOMOPOLAR SEMICONDUCTOR TAKING INTO ACCOUNT THEIR INTERACTION WITH THE LATTICE VIBRATIONS. V.L.Bonch-Bruevich.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 254-60 (1956). In Russian.

The interaction between electrons and phonons in a homopolar semiconductor is taken into account in an investigation of the stationary electron distribution; this interaction is not merely considered as the cause of transitions between stationary states of "free" electrons and phonons. The limiting cases of high and low temperatures are

considered. It is shown that due to the electron–phonon interaction the electrical conductivity of an intrinsic semiconductor does not vanish at absolute zero. A.

537.311.33

2204. THE NERNST EFFECT IN ATOMIC SEMICONDUCTORS, TAKING INTO ACCOUNT THE SCATTERING OF ELECTRONS AND HOLES AT IMPURITY IONS. Yu.N.Obraztsov.
Zh. tekh. Fiz., Vol. 25, No. 6, 995-1002 (1955). In Russian.

The isothermal Nernst coefficient is calculated assuming impurity scattering of both types of carrier. The easier case of only one type of carrier is considered in detail and the temperature dependence of the effect is derived. Simultaneous observations of Nernst coefficient, Hall coefficient and conductivity can be used to calculate the relative contributions of impurity and lattice scattering at a given temperature. J.B.Arthur

537.311.33

2205. DIFFUSION OF CURRENT CARRIERS IN A SEMICONDUCTOR IN THE PRESENCE OF AN EXTERNAL ELECTRIC FIELD. É.I.Rashba.
Zh. tekh. Fiz., Vol. 26, No. 7, 1415-18 (1956). In Russian.

Exact expressions for the distribution of photoholes in the presence of a uniform field are derived for the case of point and line illumination. Filamentary and semi-infinite geometries are considered and both volume and surface recombination are taken into account. It is suggested that the volume lifetime and surface recombination velocity may be determined by two measurements of photodecay, one with no field and one with a large field.

J.B.Arthur

537.311.33

2206. THEORY OF SEMICONDUCTORS OF THE TYPE $A^{III}B^{V}$. A.I.Gubanov.
Zh. tekh. Fiz., Vol. 26, No. 10, 2170-8 (1956). In Russian.

Seraphin's theory of compounds of the type $A^{III}B^{V}$, based on a one-dimensional model, is criticized. Semi-quantitative considerations explain the widening of the forbidden band in compounds $A^{III}B^{V}$ relative to the iso-electronic elements of the fourth group. These considerations are partly based on perturbation theory and partly on the method of localized valencies and use Shockley and Bardeen's expression for the mobility of electrons and holes.

Electrical Research Association

537.311.33

2207. THEORY OF THE METAL–SEMICONDUCTOR CONTACT. S.U.Umarov and L.G.Gurvich.
Zh. tekh. Fiz., Vol. 26, No. 10, 2179-84 (1956). In Russian.

A refinement of the theory of metal–semiconductor contact, based on the usual diffusion equation and the Poisson's equation, and solved by series expansions which represent the relation between field strength and concentration. When the diffusion current is negligible compared with the ohmic current, which is the case in the contact zone, the relation field–concentration takes a finite form. Similar approximate formulae are obtained for voltage discontinuity at the contact for any degree of ionization.

Electrical Research Association

537.311.33 : 538.632 : 538.66

2208. THEORY OF HALL AND NERNST EFFECTS IN A SEMICONDUCTOR WITH AN IMPURITY BAND. M.I.Klinger, V.G.Novikova and V.N.Agarkova.
Zh. tekh. Fiz., Vol. 26, No. 10, 2185-94 (1956). In Russian.

The theory of the Hall and the Nernst effects is first evolved for a metal with a narrow conduction band, and then for a semiconductor with an impurity band. The latter derivation is based on a formula for Nernst's constant Q for an arbitrary dispersion function $\epsilon(\vec{k})$ of the zonal electron. The temperature relations of the two constants R(T) and Q(T) are then investigated and compared with some experimental results. Electrical Research Association

537.311.33

2209. ELECTRICAL PROPERTIES OF ALUMINIUM ANTIMONIDE. F.Kover.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 648-50 (Aug. 13, 1956). In French.

Specimens prepared by fusion of the two pure elements were p-type and of various carrier concentration. The Hall and the Seekeck coefficients and the resistivity are plotted as a function of the absolute temperature. Variation of the Hall mobility with the absolute temperature is also plotted. The effective mass of the holes is of the $3 \times 10^{-2} m_0$. The degeneracy implies a strong curvature of the valence band. W.Bardsley

537.311.33

2210. PIEZORESISTANCE IN BISMUTH. R.W.Keyes.
Phys. Rev., Vol. 104, No. 3, 665-6 (Nov. 1, 1956).

It is pointed out that the piezoresistance phenomena in bismuth are consistent with some of the multi-valley models of bismuth which have been proposed by various authors, and that certain features of these models are in fact implied by the piezoresistance data. A.

537.311.33

2211. INFRARED CYCLOTRON RESONANCE IN Bi, InSb AND InAs WITH HIGH PULSED MAGNETIC FIELDS. R.J.Keyes, S.Zwerdling, S.Foner, H.H.Kolm and B.Lax.
Phys. Rev., Vol. 104, No. 6, 1804-5 (Dec. 15, 1956).

Describes results of room temperature experiments using wavelengths between 10 and 22 μ and pulsed fields up to 3.2×10^5 oersted. The absorption peaks are broad due to dimensional effects, which are eliminated by using reflection techniques. The variation of m^X with magnetic field was obtained for InSb and Bi; for InSb m^X/m varies between 0.017 and 0.031, in agreement with thermoelectric data, and for Bi the effective mass is anisotropic and may be correlated with de Haas–van Alphen data. Preliminary results are also given for InAs, and cyclotron resonance effects have also been observed for zinc and graphite. E.P.Wohlfarth

537.311.33

2212. ANOMALOUS LORENZ NUMBERS IN MIXED SEMICONDUCTORS. P.J.Price.
Proc. Phys. Soc. B, Vol. 69, Pt 8, 851-4 (Aug., 1956).

Goldsmid (Abstr. 3668/1956) has reported for BiTe anomalously large measured values of the Lorenz number Λ, defined by $\kappa = \kappa_1 + \Lambda T\sigma$, where κ and σ are the thermal and electrical conductivities, and κ_1 the contribution to κ due to the lattice. Goldsmid has explained the anomaly solely in terms of ambipolar thermodiffusion, but with the aid of a more complete formula for Λ, and consideration of excitons in addition to conduction and valence electrons, a more complete model is obtained. In the case of InSb neither the ambipolar nor the exciton contributions appear adequate to explain the anomaly. J.B.Birks

537.311.33

2213. THE ELECTRICAL PROPERTIES OF THE CHALCOGENIDES OF Bi. II. THE ELECTRICAL PROPERTIES OF Bi_2Se_3. P.P.Konorov.
Zh. tekh. Fiz., Vol. 26, No. 7, 1394-9 (1956). In Russian.

For Pt I see Abstr. 372/1957. Measurements were made on n-type single crystals in directions parallel and perpendicular to cleavage planes, with the following results: (1) Conductivity, parallel, $2 \times 10^3 \text{ohm}^{-1}\text{cm}^{-1}$ at room temperature with negative temperature coefficient. (2) Conductivity, perpendicular, $60 \text{ohm}^{-1}\text{cm}^{-1}$ at room temperature. (3) Hall constant, $0.2 \text{cm}^3\text{coulomb}^{-1}$, equivalent to a concentration of $3 \times 10^{19} \text{cm}^{-3}$. (4) Room temperature Hall mobility, parallel, $500 \text{cm}^2\text{V}^{-1}\text{sec}^{-1}$; perpendicular, $20 \text{cm}^2\text{V}^{-1}\text{sec}^{-1}$; temperature dependence roughly as $T^{-1/2}$ from 130 to 300°K, as $T^{-3/2}$ from 300 to 500°K and as T^{-3} above 500°K. Thermoelectric power was also measured. It is deduced from the results that intrinsic conduction occurs above about 500°K. J.B.Arthur

537.311.33

2214. THE ELECTRICAL PROPERTIES OF THE CHALCOGENIDES OF Bi. III. THE ELECTRICAL PROPERTIES OF Bi_2Te_3. P.P.Konorov.
Zh. tekh. Fiz., Vol. 26, No. 7, 1400-5 (1956). In Russian.

For Pt II see preceding abstract. The results are similar to those for Bi_2Se_3. Most single crystals showed n-type conduction, but all poly- and macrocrystalline specimens were p-type. In the single crystals, intrinsic conduction occurred just above room temperature. The calculated energy gap width was 0.3 eV. In the light of the results for both Bi_2Se_3 and Bi_2Te_3, a conduction model is suggested. J.B.Arthur

537.311.33 : 537.312.5 : 537.529

2215. CHANGES IN CONDUCTIVITY RESULTING FROM BREAKDOWN IN CADMIUM SULPHIDE SINGLE CRYSTALS. J.Woods.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 975-80 (Oct., 1956).

For small applied fields the resistivity of a pure cadmium sulphide crystal is very high. For fields greater than a critical value, however, dielectric breakdown occurs and large currents flow. If the crystal is protected from destruction by a limiting resistor it is found on re-measurement at small fields, after the passage of a high current, that the conductivity and photosensitivity have been greatly increased. The increase in conductivity is greater, the larger the current passed through the crystal after the initial breakdown. This

activating effect has been examined in detail, and it is shown that the changes which occur as a result of the passage of high currents take place largely in the bulk of the crystal. A.

537.311.33

2216. SOME ASPECTS OF THERMAL CONVERSION IN GERMANIUM. H.Kroemer.
"Transistors", pp. 132-5. See Abstr. 385 (1957).

It is known that a slight copper contamination on n-type germanium may convert the germanium to p-type upon heat treatment. If, however, the germanium is in contact with a molten metal during the heating process, then the metal soaks up almost all of the copper and no conversion occurs. This is consistent with the high solubility of copper in molten metals. It explains why no conversion has been observed after the heat treatment during the processing of alloy transistors. It also furnishes a method of preventing thermal conversion generally during other kinds of heat treatments. A.

537.311.33

2217. ENERGY GAP AND ELECTRICAL CONDUCTANCE OF HEXAGONAL GERMANIUM DIOXIDE. H.A Papazian.
J. appl. Phys., Vol. 27, No. 10, 1253-4 (Oct., 1956).

Sublimation of GeO_2 powder in vacuo led to the growth of small single crystals of hexagonal GeO_2 along the c-axis. Absorption measurements gave an edge at 2230 A corresponding to an energy gap of 5.54 eV. An upper limit for the room temperature conductivity was 10^{-15} ohm^{-1}cm^{-1} and at 400°C was 5×10^{-10} ohm^{-1}cm^{-1} for sintered pellets. C.A.Hogarth

537.311.33

2218. EXCESS NOISE IN DEFORMED GERMANIUM. J.J.Brophy.
J. appl. Phys., Vol. 27, No. 11, 1383-4 (Nov., 1956).

Germanium specimens were deformed in air by bending round formers of 1 cm and 0.5 cm radius at 600°C. The noise level is greatly increased by the deformation, follows the 1/f law from 2 c/s to 10 kc/s at least, and the noise power has a fourth power dependence on current. C.A.Hogarth

537.311.33 : 538.113

2219. SECULAR SOLUTION OF CYCLOTRON RESONANCES FOR ELECTRONS IN GERMANIUM. L.Gold.
J. Electronics, Vol. 2, No. 2, 131-3 (Sept., 1956).

A generalization of Shockley's relation for cyclotron resonance of electrons in semiconductors permits calculation of the resonant frequencies in n-germanium for any orientation of the magnetic field relative to the crystal axes. The method consists of transforming the Hamiltonian in the ellipsoidal energy surface reference frame to the cubic axes from whence the equations of motion lead to a secular determinant whose value defines the resonances. A.

537.311.33

2220. MASS RATIO AND MAGNETORESISTANCE IN N-TYPE GERMANIUM. G.C.Della Pergola and D.Sette.
Phys. Rev., Vol. 104, No. 3, 598-9 (Nov. 1, 1956).

An upper limit of 15.7 for the ratio of longitudinal to transverse mass of conduction electrons at room temperature was determined by magnetoresistance measurements on n-type germanium single crystals. Experimental values of this ratio range between 7.0 and 11.4. A.

537.311.33

2221. CYCLOTRON RESONANCE EXPERIMENTS IN SILICON AND GERMANIUM. R.N.Dexter, H.J.Zeiger and B.Lax.
Phys. Rev., Vol. 104, No. 3, 637-44 (Nov. 1, 1956).

Experimental techniques are described for cyclotron resonance in silicon and germanium at 9000 Mc/s, 24 000 Mc/s, and higher frequencies. Results are presented for electrons and holes in both germanium and silicon. The parameters for the heavy holes are evaluated, with corrections from an approximate theory of line shape for warped surfaces. Observations of the harmonics of cyclotron resonance of the heavy holes in germanium and silicon are described. A.

537.311.33 : 548.7

2222. LATTICE-SCATTERING MOBILITY OF HOLES IN GERMANIUM. H.Ehrenreich and A.W.Overhauser.
Phys. Rev., Vol. 104, No. 3, 649-59 (Nov. 1, 1956).

The lattice-scattering mobility of holes in germanium is calculated by using the transition probabilities for scattering by acoustical and optical phonons derived in an earlier paper, in which both the rigid- and deformable-ion models were used to determine the interaction between holes and the lattice. Coupled Boltzmann equations are considered, describing the distribution of carriers under the influence of an electric and phonon field in the two valence bands of germanium, degenerate at $k = 0$. The results involve two previously described constants C_1 and C_4 which are treated as arbitrary parameters. Results are presented for several sets of these parameters and also for values of the temperature $\Theta = 300°K$ and 500°K which might correspond to the fundamental optical frequency of the germanium lattice. The curves, $\log\mu$ v. $\log T$, closely resemble straight lines over the lattice-scattering range. It is possible to find values of C_1 and C_4 for both rigid- and deformable-ion models which agree well with the observed mobility if $\Theta = 300°K$ but not if $\Theta = 500°K$. The question as to whether these values of C_1 and C_4 are correct is not considered in this paper. A.

537.311.33

2223. CONDUCTION BAND STRUCTURE OF GERMANIUM–SILICON ALLOYS. M.Glicksman and S.M.Christian.
Phys. Rev., Vol. 104, No. 5, 1278-9 (Dec. 1, 1956).

Previous measurements of the magnetoresistance and Hall effect in n-type germanium–silicon alloy single crystals have been extended to higher silicon composition. These observations at room temperature show that in alloys with silicon content greater than 23%, the electronic conduction takes place in energy minima which are spheroids oriented along the [100] axes in the reduced zone. It is inferred from these observations that electrons in these minima have about the same effective mass in the alloys (and probably in germanium) as in pure silicon. A.

537.311.33

2224. THE ELECTRICAL CONDUCTIVITY OF Ge–Si ALLOYS IN THE LIQUID STATE. M.S.Ablova, O.D.Elpat'ebskaya and A.R.Regel'.
Zh. tekh. Fiz., Vol. 26, No. 6, 1366-8 (1956). In Russian.

Five specimens whose Si content ranged from 0 to 50 mol.% were studied. From the temperature dependence of the conductivity the following were determined: the gap width, conductivity change on melting and maximum conductivity in the liquid state. The variation of gap width with composition confirms Levitas' results (Abstr. 342/1956). The other two parameters show a maximum at 50% Ge/50% Si, attributed to a radical change in the nature of the bonding on melting. J.B.Arthur

537.311.33

2225. CONTRIBUTION TO THE STUDY OF THE MOBILITY OF THE CHARGE CARRIERS IN InSb. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2707-10 (June 4, 1956). In French.

Measurements of the Hall constant and the resistivity as functions of the temperature, and of the Hall constant as a function of the magnetic field indicate that the carrier mobility is a function of the magnetic field strength C.A.Hogarth

537.311.33

2226. EXCESS NOISE IN InSb. G.H.Suits, W.D.Schmitz and R.W.Terhune.
J. appl. Phys., Vol. 27, No. 11, 1385 (Nov., 1956).

Measurements at 20 c/s show the absence of excess noise in most specimens examined and a very low level in the others. C.A.Hogarth

537.311.33

2227. CARRIER LIFETIME IN INDIUM ANTIMONIDE. G.K.Wertheim.
Phys. Rev., Vol. 104, No. 3, 662-4 (Nov. 1, 1956).

The lifetime in well-compensated, single-crystal indium antimonide samples has been obtained as a function of temperature between 130° and 250°K. The results suggest that the lifetime is limited by radiative recombination at high temperatures and by a recombination centre mechanism at low temperatures. A.

537.311.33

2228. A PULSE METHOD FOR MEASUREMENT OF HALL COEFFICIENT AT LOW TEMPERATURES: SOME RESULTS ON INDIUM ANTIMONIDE. R.F.Broom and A.C.Rose-Innes.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1269-75 (Dec., 1956).

A pulse method has been developed for the measurement of Hall coefficients in high resistivity semiconductors. This technique is specially useful at low temperatures since it greatly reduces heating of the specimens. Measurements have been made over the range 90°K - 1.4°K on several p-type indium antimonide samples of different impurity concentration. From the variation of Hall coefficient with temperature the energy gap between the impurity levels and the valence band has been estimated. The results are consistent with the empirical formula of Pearson and Bardeen (1949) connecting the energy gap with impurity concentration in p-type silicon. A.

537.311.33

2229. MAGNETO-BAND EFFECTS IN InAs AND InSb IN D.C. AND HIGH PULSED MAGNETIC FIELDS. S.Zwerdling, R.J.Keyes, S.Foner, H.H.Kolm and B.Lax.
Phys. Rev., Vol. 104, No. 6, 1805-7 (Dec. 15, 1956).

The variation of energy gap with magnetic field has been investigated for InAs and InSb at fields up to 35 000 oersted (d.c.) and to 220 000 oersted (pulsed), at room temperature. The average variation in energy gap with field $\Delta\epsilon/B$ was 1.7×10^{-7} eV/oersted for InSb at the lower fields and 9.3×10^{-8} eV/oersted for InAs. C.A.Hogarth

537.311.33

2230. FIELD INDUCED DOPING OF PbS LAYERS. D.E.Martz, L.G.LaMarca and R.S.Witte.
J. appl. Phys., Vol. 27, No. 11, 1382-3 (Nov., 1956).

P-type PbS layers chemically deposited on soda-lime glass show a change to n-type by application of a transverse electric field, the effect increasing with temperature. The effect is absent for hard glass or silica substrates. It is attributed to the entry of sodium ions into the PbS layer from the glass. G.F.J.Garlick

537.311.33

2231. CONTROLLED CONDUCTIVITY IN LEAD SULPHIDE SINGLE CRYSTALS. J.Bloem.
Philips Res. Rep., Vol. 11, No. 4, 273-336 (Aug., 1956).

Lead sulphide single crystals, pure or doped with Ag or Bi, were reheated at various sulphur pressures in order to influence the stoichiometric composition of the crystals. At a few different temperatures series of crystals were reheated and the electrical properties measured after cooling to room temperature. Undoped crystals change from n- to p-type at a certain sulphur pressure, whereas PbS-Bi or PbS-Ag show this "equivalence atmosphere" at higher and lower sulphur pressures respectively. Moreover, for the latter systems there appears to be a range of atmospheres where the electron or hole concentrations are nearly equal to the concentration of added Bi or Ag ions (range of controlled valency). At higher heating temperatures these regions become narrower, doped and undoped samples showing the same properties. Thermoelectric measurements at room temperature showed the effective mass of electrons and holes in PbS to be about 0.2 to 0.5 of the free electronic mass. From Hall effect in combination with resistance it was found that the mobilities of electrons and holes are also of the same order. In a few different ways the thermal energy gap at room temperature was determined to be about 0.3 eV. From an analysis of the experimental results, using the theory of Schottky and Wagner on lattice imperfections as applied by Kröger, Vink and Van den Boomgaard, it was calculated that at temperatures between 800 and 1200° K the thermal energy gap has a width of 0.65 ± 0.10 eV, and that the effective mass of the charge carriers will be about 0.50 ± 0.20 of the free electronic mass. The concentration of vacancies on lead and sulphur sites in thermal equilibrium (their product being defined as the Schottky constant) may be represented as $k_S = 2.5 \times 10^{43} \exp(-E/kT)$, with E = 1.75 eV. A simple model showed that, compared with the normal lattice, the ions surrounding a vacancy have acquired equilibrium position further away from the vacancy. Some calculations have been carried out on the influence of foreign ions and the position of the levels caused by vacancies on the position of the p/n equivalence atmosphere as a function of the heating temperature. A.

537.311.33

2232. APPLICATION OF THE LATTICE MODEL TO SEMICONDUCTORS OF THE LEAD SULPHIDE TYPE. T.K.Rebane.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 353-4 (1956). In Russian.

The lattice model as applied by Coulson (Abstr. 9433/1954) to metals, graphite and boron nitride is applied to semiconductors of the PbX type (X = S, Se, Te). Two possible models are considered In this way the width of the forbidden gap and the effective masses of electrons and holes are calculated. Comparison between theory and experiment is made and the agreement is thought to warrant further work with this model. W.Bardsley

537.311.33

2233. VOLUME GENERATED CURRENTS AND SECONDARY EFFECTS IN AMORPHOUS SELENIUM FILMS. W.E.Spear.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1139-47 (Nov., 1956).

Charge carriers are generated in amorphous Se films by electron bombardment. The films, prepared by evaporation, are between 3 and 9 μ thick and carry Al electrodes. The resulting current is studied in relation to the average depth of penetration of the bombarding beam. The experiments confirm the exceptionally large effective mobility of positive holes reported by Weimer. It is shown that secondary effects, which cause the entry of additional charge carriers from the electrodes normally play an important part. Saturation of the measured current with applied voltage is observed only with small bombarding currents when the generation of electron–hole pairs is confined to a narrow region near the top electrode. When the excitation extends throughout the specimen the use of a pulsed bombarding beam makes it possible to distinguish the true volume generated current from that due to secondary effects. The experiments lead to values between 18 and 25 eV for the average energy used in the production of an electron–hole pair. The mechanism whereby secondary carriers are drawn from the electrodes is briefly discussed. A.

537.311.33

2234. PARAMAGNETIC SPIN–LATTICE RELAXATION IN A SEMICONDUCTOR. A.Abragam and J.Combrisson.
C.R. Acad. Sci. (Paris), Vol. 243, No. 6, 576-8 (Aug. 6, 1956). In French.

Reports results of measurements at 2° K and frequency 9 kMc/s on As impurities (concentration 10^{17} cm^{-3}) in Si. The spin–lattice interaction was found to be weak and the relaxation complicated due to the presence of several long relaxation times. E.P.Wohlfarth

537.311.33

2235. PROPERTIES OF SILICON DOPED WITH MANGANESE. R.O.Carlson.
Phys. Rev., Vol. 104, No. 4, 937-41 (Nov. 15, 1956).

Manganese acts as a donor impurity in silicon, introducing a level 0.53 ± 0.03 eV from the conduction band. The distribution coefficient of manganese in silicon is $\sim 10^{-5}$ as determined by radioactive tracer techniques and checked by electrical measurements. Precipitation limits the electrically active manganese to 5×10^{14} cm^{-3} in crystals grown from a melt by the Czochralski technique. Higher concentrations can be obtained by diffusing in manganese at 1200° C and quenching. Manganese introduces recombination centres into a crystal with observable effects at the 10^{12} cm^{-3} concentration in the crystals. Studies of Hall mobility under external radiation and lifetime studies by the photoconductive decay method show the presence of electron traps. Heating to only 200-300° C causes the precipitation of the manganese and loss of electrical activity. A.

537.311.33

2236. PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTING SYSTEMS. I. ELECTRICAL PROPERTIES AND STRUCTURE OF SOME MATERIALS IN THE SYSTEM Tl–Sb–Se. B.T.Kolomiets and N.A.Goryunova.
Zh. tekh. Fiz., Vol. 25, No. 6, 984-94 (1955). In Russian.

Alloys between Tl_2Se and Sb_2Se_3 were prepared by direct fusion and slow cooling. All were p-type semiconductors. Thermoelectric power, electrical conductivity, Hall effect and photoconductive spectral response were studied and evidence was obtained of the formation of a compound $Tl_2Se.Sb_2Se_3$ (rhombic a = 4.15, b = 4.50, c = 12.0 A). Preliminary work on alloys of Tl_2Se with As_2Se_3 and As_2Te_3 is reported. Amorphous glass-like materials were observed. C.H.L.Goodman

537.311.33

2237. PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTING SYSTEMS. II. ELECTRICAL PROPERTIES AND STRUCTURE OF MATERIALS IN SYSTEMS OF THE THALLIUM, ANTIMONY AND ARSENIC SELENIDES. N.A.Goryunova and B.T.Kolomiets.
Zh. tekh. Fiz., Vol. 25, No. 12, 2069-78 (1955). In Russian.

For Pt I see preceding abstract. Materials in the systems $Tl_2Se.As_2Se_3$–$Tl_2Se.Sb_2Se_3$ and Sb_2Se_3–As_2Se_3 were prepared by direct fusion and subsequent slow cooling. All specimens were p-type semiconductors. Curves of electrical conductivity v. temperature and the corresponding activation energies are given. Evidence of glass-like amorphous structure was found for compositions rich in As_2Se_3. C.H.L.Goodman

537.311.33

2238. PROPERTIES AND STRUCTURE OF TERNARY SEMICONDUCTING SYSTEMS. III. CONDUCTIVITY AND PHOTOCONDUCTIVITY IN SYSTEMS OF THE THALLIUM, ANTIMONY AND BISMUTH SULPHIDES. N.A.Goryunova, B.T.Kolomiets and A.A.Mal'kova.
Zh. tekh. Fiz., Vol. 26, No. 8, 1625-33 (1956). In Russian.

For Pt II see preceding abstract. Tl_2S–Sb_2S_3: a marked minimum in conductivity (σ) and a maximum in thermal activation energy were found near $Tl_2S.3Sb_2S_3$. X-ray analysis showed this to be a new compound; a further compound was indicated near $2Tl_2S.Sb_2S_3$. Substitution of As for Sb in the alloy $Tl_2S.Sb_2S_3$ shifted the peak of the photoconductive spectral response (P) to longer wavelengths.

Bi_2S_3–Sb_2S_3: a complete range of semiconducting solid solutions appeared to form. A minimum in σ was observed near 40% Sb_2S_3. Small additions of S to the 50 : 50 alloy shifted P to longer wavelengths, but larger amounts (i.e. $Bi_2S_3.Sb_2S_5$) gave the response of pure S. C.H.L.Goodman

537.311.33

2239. HYDROGEN AS A DONOR IN ZINC OXIDE. D.G.Thomas and J.J.Lander.
J. chem. Phys., Vol. 25, No. 6, 1136-42 (Dec., 1956).

Hydrogen is found to diffuse into and increase the conductivity of single ZnO crystals. The diffusion rates have been obtained, as well as the temperature and pressure dependencies of the quantity of hydrogen in the crystal. This quantity is found to be influenced by the electrons already in the crystal. It is thought likely that hydroxyl groups are formed from the hydrogen and oxide ions. The donor centre has an ionization energy of 0.04 eV. A.

537.311.33 : 548.7

ELECTRICAL CONDUCTIVITY OF THE CdS CRYSTAL. See Abstr. 1737-8

537.311.33

2240. ON THE ANOMALOUS RECTIFICATION OF CUPROUS SULPHIDE DETECTORS. M.Anastassiades and D.Ilias.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 958-60 (Sept., 1956).

A point contact on CuS was found to rectify in one direction up to 0.3 V r.m.s. and in the opposite direction for larger applied voltages. This effect is very frequency-dependent and oscillograms of the current–voltage characteristic show hysteresis effects and portions of negative resistance. It is suggested that rectification at the point contact governs the low voltage behaviour, but breakdown at the point with larger voltages leaves the base contact to carry on rectification in the opposite direction. K.W.Plessner

537.311.33 : 548.52

2241. THE PREPARATION OF SINGLE AND MULTIPLE P-N JUNCTIONS IN SINGLE CRYSTALS OF GERMANIUM. A.R.Moore. "Transistors", pp. 77-81. See Abstr. 385 (1957).

A method and an apparatus are described for the preparation of junctions in crystals of germanium. The composition of the melt from which a crystal grows is changed suffenly by rotation of a carbon block containing several melt compositions. A system of canals and valves keeps the crystal growing and minimizes mixing of the melts during the change-over. In principle any number of junctions between germanium of arbitrary composition can be formed. A.

537.311.33

2242. SLOW RELAXATION PHENOMENA IN JUNCTION DIODES. T.B.Watkins.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1353-5 (Dec., 1956).

The "slow" variation in barrier height resulting from interaction of change carriers with the germanium oxide surface layer is observed in Ge junction diodes as a slow variation of reverse current. C.A.Hogarth

537.311.33

2243. THE BREAKDOWN OF p–n JUNCTIONS IN Ge AT THE COLLISION [AVALANCHE] VOLTAGE. A.P.Shotov.
Zh. tekh. Fiz., Vol. 26, No. 8, 1634-45 (1956). In Russian.

The avalanche voltage in a reverse-biased junction was measured as a function of resistivity, junction width and junction temperature. Junctions were prepared by alloying In on to n-type Ge or by diffusing Sb into p-type Ge, the resistivity range of the starting material being 0.15 to 50 ohm cm. 1 μsec voltage pulses were used to avoid the heating effects. It is concluded that breakdown is due to ionization by electron collision and the ionization coefficient is calculated. The increase in the breakdown voltage with temperature is explained in terms of the temperature dependence of the ionization coefficient. J.B.Arthur

537.311.35

2244. THE ACTION OF A CONSTANT ELECTRIC FIELD ON A SUSPENSION OF METALS AND SEMICONDUCTORS IN LIQUID DIELECTRICS. L.G.Gindin, I.N.Putilova and L.M.Moroz.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 2, 277-9 (1954). In Russian.

The behaviour of 0.1% by weight suspensions of micron-sized particles in aviation petrol. Pt showed high conductivity (σ) at the lowest fields. Cu had small σ below 100 V/cm which gradually increased with field until at 400 V/cm it jumped suddenly by a factor $> 10^3$. Boron carbide below 1000 V/cm showed a small, apparently cataphoretic σ; near 3000 V/cm this increased sharply by about 10^2-10^3. Cu_2O behaved similarly, though σ tended to grow with time as the sharp increase in σ near 12 000 V/cm was approached. With both Cu_2O and boron carbide the inter-electrode "bridge" formed at high fields was stable on removing the applied voltage. The high σ of Pt suspensions was attributed to the absence of surface oxide. C.H.L.Goodman

537.312 : 536.212

OBSERVED DEPENDENCE OF THE LOW-TEMPERATURE ELECTRICAL CONDUCTIVITY OF GRAPHITE ON TEMPERATURE, TYPE, NEUTRON IRRADIATION, AND BROMINATION. See Abstr. 2109

537.312.5 : 548.7

2245. ON THE INFLUENCE OF THE NEAR INFRARED AT LOW TEMPERATURES ON THE PROPERTIES OF SELENIUM PHOTOCELLS. G.Blet.
C.R. Acad. Sci. (Paris), Vol. 243, No. 11, 798-800 (Sept. 10, 1956). In French.

The low temperature sensitivity can be increased by irradiation with near infrared. An explanation in terms of acceptor-type traps is given. C.A.Hogarth

537.312.5

2246. PHOTOELECTRIC WORK FUNCTION FROM ANALYSIS OF EMISSION IN AN ACCELERATING FIELD. P.E.Carroll.
Phys. Rev., Vol. 104, No. 3, 660-1 (Nov. 1, 1956).

The photoelectric work function can be determined by analysis of monochromatic photoelectric emission in an accelerating field. A plot of I v. $E^{1/2}$ gives a straight line for incident light a few tenths of an eV from the threshold. The ratio of the zero-field intercept to the slope of this line is directly proportional to $h(\nu-\nu_0)$ and is independent of the intensity of the incident light. The work function can be determined from this ratio for both metallic and semiconducting emitters. A graphical method is developed for eliminating the dependence of the determination on the field factor and the parameter, m, and the dielectric constant, k_e, in the emission equation for semiconductors. The work function of Te is determined by the present method from data of Apker, Taft and Dickey. The value obtained, 4.78 eV, is in good agreement with their determination. A.

537.312.5 : 537.311.33

2247. THEORY OF PHOTOCONDUCTIVITY IN SEMICONDUCTOR FILMS. R.L.Petritz.
Phys. Rev., Vol. 104, No. 6, 1508-16 (Dec. 15, 1956).

Photoconductive films of the lead salt family are composed of a system of crystallites separated by intercrystalline barriers. The crystallites are lead salts while the intercrystalline barriers are an oxide of lead or of the lead salt. Space charge regions are present at the surface of the crystallites. The lifetime of hole-electron pairs is determined in part by surface states while the resistivity is strongly affected by intercrystalline barriers. A model is analysed which incorporates the above characteristics of a photoconductive film, except for the space charge effects. It is assumed that the primary photoeffect is absorption of light and production of hole-electron pairs in the crystallites. The change in conductivity results from a change in majority carrier density in the crystallites, and from reduction of intercrystalline barrier potentials. Equations are developed for the response to radiation, for the noise, and for the limit of sensitivity of the detector. These expressions contain familiar semiconductor parameters, and a new parameter which characterizes the relative importance of the change in carrier density as compared to the change in barrier potential. No attempt is made to calculate the parameters, but measurements necessary for their evaluation are briefly discussed. This permits a prediction of numerical values for responsivity, noise, and sensitivity which can be compared with experiment. A.

537.312.5 : 535.37

2248. THE PHOTOCONDUCTIVITY OF PHOSPHORS WITH VARIOUS LUMINESCENCE MECHANISMS. II. H.Gobrecht, D.Hahn and H.J.Kösel.
Z. Phys., Vol. 146, No. 1, 87-94 (1956). In German.

For Pt I see Abstr. 3494 (1954). Several electroluminescent sulphides are shown to have high dark currents and photocurrents. Oxidation of sulphides by firing in air produces electroluminescence and conductivity, while removal of the oxide by acetic acid generally removes these properties. S.T.Henderson

537.312.5 : 535.37

2249. THE TEMPERATURE DEPENDENCE OF THE DARK AND PHOTOCURRENTS OF PHOSPHORS. H.Gobrecht, D.Hahn and H.J.Kösel.
Z. Phys., Vol. 146, No. 1, 95-106 (1956). In German.

See Abstr. 3495 (1954), and the preceding abstract. In experiments

up to 250° C saturation was observed only for the photocurrent in ZnS(Mn) and Zn_2SiO_4(Mn) (above about 100°C) but not for the dark current in these phosphors or for either current in other zinc sulphides. "Conductivity glow curves" were taken by excitation with ultraviolet at −180° C, followed by decay of the luminescence, and then heating at 80-100°/min with continuous measurement of the dark current. The location of traps, agreeing in some cases with those shown by optical glow curves, was revealed by peaks between 100° and 200° K for a variety of zinc sulphides, Zn_2SiO_4(Mn) and CaSrS(Bi). Some other experiments concerned the spectral distribution of the excitation of photoconductivity in sulphides at different temperatures and field strengths. In the discussion of the results, emphasis is placed on the disturbing effects of the powdered form of the phosphors.

S.T.Henderson

537.312.5

2250. KINETICS OF THE GROWTH OF PHOTOCURRENT AND THE PHOTOCONDUCTIVITY QUENCHING EFFECT IN CdS. A.D.Shneĭder.
Zh. tekh. Fiz., Vol. 26, No. 7, 1428-32 (1956). In Russian.

The time taken for the photocurrent to reach a steady value has been shown to increase with the length of time the crystal has been in the dark. A short period of infrared illumination had the same effect as a long period of darkness. The "quenching" of a photoconductive signal by simultaneous infrared illumination has also been studied. A proposed model invokes a double optical transition, assuming trapping levels at 1.5 eV and 0.8 eV below the conduction band, corresponding to the wavelengths at which maximum quenching was observed. J.B.Arthur

537.312.5

2251. QUENCHING OF PHOTOCONDUCTIVITY IN HgS. A.D.Shneĭder.
Zh. tekh. Fiz., Vol. 26, No. 7, 1433-6 (1956). In Russian.

The photoconductive peak was found to occur at 0.63μ at room temperature. No infrared quenching was observed at this temperature but an increasing amount occurred as the temperature was lowered. Low temperature results on HgS were similar to the room temperature observations on CdS by the same author (see preceding abstract). J.B.Arthur

537.312.5

2252. PROPERTIES OF CADMIUM SULPHIDE PHOTOCELLS IRRADIATED BY γ-AND β-RAYS. S.V.Svechnikov.
Zh. tekh. Fiz., Vol. 26, No. 8, 1646-50 (1956). In Russian.

Three types of photocells were studied: thin single crystal, thick single crystal and polycrystalline layer. The sensitivities to β- and γ-radiation are plotted as a function of energy of radiation and of voltage applied to cell. Co^{60}, P^{32} and Ir^{192} were used as sources. Thin specimens were found to be more sensitive to soft radiation and thick specimens to hard. The growth and decay time constants of the photocurrent were of the order of tens or hundreds of seconds. Comparisons are made with the author's X-ray observations (Abstr. 6053/1953 and Zh. tekh. Fiz., Vol. 23, No. 6, 942/1953). J.B.Arthur

537.312.62

2253. ON THE INTERMEDIATE STATE OF SUPERCONDUCTORS WHEN CARRYING A CURRENT. L.Rinderer.
Helv. phys. Acta, Vol. 29, No. 4, 339-74 (1956). In German.

The change in resistance on destruction of superconductivity by currents was investigated with cylindrical samples of tin of varying purity and compared with current theories. At residual resistances $R_{3.8}/R_{300} = 2.10^{-4}$ the transitions follow very closely the course given by Langevin, London and Shoenberg. With an additional longitudinal magnetic field the transition curves agree well with an extension of the London theory. Further, with a transverse field additional to the current, it was possible to plot the region of the intermediate state in the H_I–H_t diagram and to determine the diameter of the core which is in the intermediate state. H.London

537.312.62

2254. EFFECTS OF PRESSURE ON THE SUPERCONDUCTING TRANSITION IN TIN. C.Hurst.
Nature (London), Vol. 178, 652-3 (Sept. 22, 1956).

In analysing his experimental results, Muench (Abstr. 373/1956) assumed that $(\partial^2 H_C/\partial p^2)_T = 0$. However, the work of Chester and Jones (Abstr.474/1954) suggests that in fact $(\partial^2 T/\partial p^2)_H = 0$. Assuming this, $(\partial^2 H_C/\partial p^2)_T$ can be evaluated from the geometry of the $H_C(T,p)$ surface; it is found that, near T_C, a plot of $H_C(p)$ should depart from linearity by 1% at 2000 atm pressure. R.G.Chambers

537.312.62

2255. BOUND ELECTRON PAIRS IN A DEGENERATE FERMI GAS. L.N.Cooper.
Phys. Rev., Vol. 104, No. 4, 1189-90 (Nov. 15, 1956).

It is suggested that the energy-gap model of a superconductor might be interpreted in terms of the properties of non-interacting pairs of electrons which arise above a quiescent Fermi sphere through the action of the phonon and screened Coulomb fields.

E.H.Sondheimer

537.312.62

2256. SURFACE ENERGIES IN SUPERCONDUCTORS. H.W.Lewis.
Phys. Rev., Vol. 104, No. 4, 942-7 (Nov. 15, 1956).

A variational method is applied to calculate the surface energy at the normal–superconducting interface in a superconductor. Both the Casimir–Gorter theory, as formulated by Bardeen, and the phenomenological energy-gap model are used. A comparison is made with the available experimental data. A.

537.312.62

2257. A FUNDAMENTAL THEORY OF SUPERCONDUCTIVITY. K.S.Pitzer.
Proc. Nat. Acad. Sci. U.S.A., Vol. 42, No. 9, 665-70 (Sept., 1956).

Suggests an energy-gap model based on the Pauling theory of metallic binding, and discusses its properties qualitatively.

R.G.Chambers

537.312.62

2258. THE EFFECT OF PRESSURE ON THE SUPERCONDUCTIVITY OF CADMIUM. N.E.Alekseevskiĭ and Yu.P.Gaĭdukov.
Zh. éksper. teor. Fiz., Vol. 29, No. 6(12), 898-9 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 2, No. 4, 762-4 (July, 1956).

Effect of pressure on superconductors has been studied in the past principally for materials with transition temperatures above 1° K. Cadmium with a transition temperature of 0.54° K in the polycrystalline form has now been investigated using the displacement of the superconductivity transition of indium to measure the pressure. Adiabatic demagnetization of iron ammonium alum was used to produce an initial temperature of 0.05-0.06° K and the critical field was investigated as a function of temperature and pressure. The change in T_k for a pressure change of 1500 atm is 8.3% or slightly larger than the corresponding values for other superconductors.

F.E.Hoare

537.312.62

2259. ON FERROMAGNETIC SUPERCONDUCTORS. V.L.Ginzburg.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 202-10 (1956). In Russian.

The properties of ferromagnetic superconductors are considered. It is shown that the presence of spontaneous magnetization complicates the detection of superconductivity in ferromagnetics. However, utilization of thin films or wires and, in some cases, of massive samples possessing a high coercive force should appreciably increase the probability of observation of superconductivity in ferromagnetic metals or alloys. A.

537.312.62

2260. EXPERIMENTAL EVIDENCE FOR THE INSTABILITY OF THE NORMAL PHASE OF SUPERCONDUCTORS. V.L.Ginzburg.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 541-3 (1956). In Russian.

Experiments show that the normal phase of a superconductor can be supercooled in presence of a weak magnetic field below the transition temperature. This phenomenon is, as the author points out, anticipated in his theory of superconductivity (Abstr. 1017/1952). The metastable normal phase can persist only if the presence of nuclei of the superconducting phase is excluded; this can, in fact, be achieved by a magnetic field the strength of which exceeds the value $H_1 = (e H_{crit}/c\hbar)\delta^2$, where δ = the penetration depth. It is possible that $H_1 > H_{crit}$. Experiments indicate that this relation applies to alloys of tin and indium (Abstr. 4106/1953, 6153/1955, 7430/1956). Conditions for the persistence of a metastable normal phase are discussed in some detail. R.Eisenschitz

537.323

2261. ON CERTAIN THERMOCOUPLES. M.Perrot and G.Péri.
J. Phys. Radium, Vol. 17, No. 6, 35S-36S (June, 1956). In French.

General results on the thermo-e.m.f.'s generated by couples consisting of metal/oxide of the same metal/metal. For example with PbO_2, Al_2O_3, ThO_2, the hot junction is negative. If a drop of distilled water is added to the oxide, the sense of the e.m.f. is reversed. A tentative explanation of the behaviour of junctions of this type is offered. C.A.Hogarth

537.323

2262. THERMOELECTRIC POWER OF GRAY TIN. A.N.Goland and A.W.Ewald.
Phys. Rev., Vol. 104, No. 4, 948-53 (Nov. 15, 1956).

Thermoelectric power measurements on grey tin filaments in the temperature range from 77 to 270°K are described. Data are presented for pure samples and for n-type and p-type samples having various impurity concentrations. Pure samples are always n-type, and exhibit a maximum of approximately −100 μV/deg K in the neighbourhood of 100°K. Other n-type samples have a maximum of about −160 μV/deg K at somewhat higher temperature, and this maximum shifts to higher temperature as the impurity concentration is increased. The p-type samples also exhibit a maximum of the order of 140-160 μV/deg K which occurs in the range 90-100°K. All p-type samples become n-type as the temperature rises, and the crossover point shifts to higher temperature as the impurity concentration increases. The measured thermoelectric power of p-type samples is analysed into electronic and phonon contributions with the help of Hall and electrical conductivity data. The relatively large phonon contribution shows a temperature dependence similar to that previously reported by others for silicon and germanium. A similar analysis of n-type material indicates a much smaller phonon contribution. Other results of the analysis based on the three types of measurements are as follows: The electron effective mass is approximately equal to the free electron mass and is about twice that for holes. Mobilities of electrons and holes are essentially the same and show the theoretically predicted $T^{-3/2}$ temperature dependence over a very limited high temperature range with a stronger dependence at lower temperatures. Only a small percentage of added p-type impurities is effective as acceptors, and the impurity concentration in undoped material is nearer to 10^{16} cm^{-3} than to the 10^{17} cm^{-3} which had previously been reported by several investigators. A.

537.323.08

2263. METHODS FOR THE PRECISE MEASUREMENT OF PELTIER EFFECT AND THERMOELECTROMOTIVE FORCE.
M. Shtenbek and P.I.Baranskiĭ.
Zh. tekh. Fiz., Vol. 26, No. 7, 1373-88 (1956). In Russian.

If the Peltier temperature difference (ΔT) between the ends of a specimen conducting a current i is annulled by introducing thermal energy W at the cooled end, then the Peltier voltage, $P = W/2i$ (provided that the system is perfectly symmetrical thermally and that there is no heat loss perpendicular to the specimen axis). For departures from thermal symmetry, curves of W against ΔT for forward and reverse current flow intersect at $W = W^*$, $(\Delta T \neq 0)$, and $P = W^*/2i$. Non-ohmic behaviour in the specimen or its contacts can be eliminated by determining the variation of P with i and extrapolating to i = 0. For an inhomogeneous specimen it is found that P is averaged in the same way as is the thermoelectric power α. An apparatus applying the new method is described in detail, and errors in measurement are analysed. An accuracy of 1% for P is claimed. A simple method for the simultaneous determination of α within 1% is also described. It is noted that experiments on Ge do not confirm the validity of the Kelvin relationship $P = \alpha T$. C.H.L.Goodman

537.324

2264. THERMOELECTRIC MICROREFRIGERATORS.
E.K.Iordanishvili and L.S.Stil'bans.
Zh. tekh. Fiz., Vol. 26, No. 5, 945-57 (1956). In Russian.

Detailed account of work referred to in Abstr. 8809/1956. Design theory for single- and multi-stage thermoelectric refrigerators is discussed. Several devices are described, in particular: a 3-stage refrigerator (4, 18, 72 elements) giving 1 watt cooling at −40°C (in 20°C ambient); mixed compression-thermoelectric refrigerators; thermostatic control apparatus. C.H.L.Goodman

ELECTRIC DISCHARGES 537.52

537.521.6

2265. THE ELECTRIC STRENGTH OF HYDROCARBON GASES.
A.E.D.Heylen and T.J.Lewis.
Brit. J. appl. Phys., Vol. 7, No. 11, 411-15 (Nov., 1956).

Measurements of the static electric strengths of a number of pure hydrocarbon gases over a range of pressure and spark-gap spacings, including the Paschen minimum are reported. A relationship between strength and molecular structure is found which, if unsaturated compounds such as ethylene, acetylene and butadiene are included, is not so simple as hitherto reported. The possible correlation of electric strength with the ultraviolet spectra and Ramsauer cross-sections of these gases is discussed briefly. Pulse discharges which occur readily in these gases at fields below the breakdown value are attributed to the exceedingly small secondary ionization coefficients (γ). A.

537.521.6 : 541.67

2266. ELECTRIC STRENGTH OF SATURATED HYDROCARBON GASES. J.C.Devins and R.W.Crowe.
J. chem. Phys., Vol. 25, No. 5, 1053-8 (Nov., 1956).

An attempt has been made to correlate the sparking potentials of nonattaching polyatomic gases with molecular structure. The investigation has included the normal alkanes containing from one to six carbon atoms, their branched chain isomers, cyclopentane, and cyclohexane. For a given electrode separation and pressure, the electric strengths of the normal alkanes increase with increasing chain length. Using a Townsend-like criterion for breakdown it has been possible, with certain assumptions, to calculate from the measurements relative cross-sections for electron scattering by these molecules. This scattering cross-section is proportional to the number of carbon–hydrogen bonds in the molecule, and independent of the number of carbon–carbon bonds. It is independent of molecular shape, i.e., of branching or cyclization. A.

537.523.3

2267. AIR-FLUX SENSITIVITY OF THE PULSES OF THE NEGATIVE POINT-TO-PLANE CORONA IN AIR AT ATMOSPHERIC PRESSURE. B.Sujak.
Nature (London), Vol. 178, 485-6 (Sept. 1, 1956).

Discusses briefly the action of negative ions in negative point corona in attaching gases. The effect of an air current, in blowing away the negative ions, is to alter the corona pulse sizes. Air velocities ~8.7 to 17.4 m/sec were used. J.D.Craggs

537.523.3

2268. SOME PROBLEMS OF THE MATHEMATICAL THEORY OF THE D.C. CORONA DISCHARGE. L.É.Tsȳrlin.
Zh. tekh. Fiz., Vol. 26, No. 11, 2524-38 (1956). In Russian.

Theory of the unipolar corona is based on a non-linear system of third-order partial differential equations. Problems of the solution of this system in the general case, when the equations do not degenerate into ordinary differential equations to be solved by elementary methods, are discussed. Previous solutions may be considered as first approximations and generalized equations may be reduced to recurrent systems of simple linear equations by expansions in terms of some corona parameter.
Electrical Research Association

537.523.4

2269. MULTIPLICITY IN THE ANODE MARKS OF SPARKS.
J.M.Somerville and C.T.Grainger.
Brit. J. appl. Phys., Vol. 7, No. 11, 400-5 (Nov., 1956).

The conditions which lead to multiplicity in the mark left on the anode by a spark of short duration in air have been studied. The anode surface condition is important in determining multiplicity and was controlled in this investigation by depositing various numbers of layers of barium stearate on clean palladium, aluminium and tin anodes. The nature of the mark is determined in the first few tenths of a microsecond of the life of the spark and depends chiefly on the number of "contaminating" layers on the anode, on the rate of rise of current in the spark and on the breakdown voltage of the spark gap. A.

537.525 : 537.542

2270. STUDIES OF RECTIFICATION IN A GAS (NITROGEN) DISCHARGE BETWEEN COAXIAL CYLINDRICAL ELECTRODES. I. THEORY OF RECTIFICATION IN A.C. SILENT DISCHARGES.
V.L.Talekar.
J. Electronics, Vol. 2, No. 3, 205-16 (Nov., 1956).

Neglecting the space-charge distortion of radial field an equation has been developed connecting rectification and the applied a.c. potential in discharge tubes of G.M. counter type for low-frequency silent discharges. An expression has also been deduced for the limiting frequency of applied potential, below which the theory if expected to be valid. It has been further pointed out that the theory could be applied to Maze counters or semiozonizers. A.

537.525

2271. STUDIES OF RECTIFICATION IN A GAS (NITROGEN) DISCHARGE BETWEEN COAXIAL CYLINDRICAL ELECTRODES. II. RECTIFICATION IN SEMIOZONIZERS. V.L.Talekar.
J. Electronics, Vol. 2, No. 3, 217-38 (Nov., 1956).

For Pt I see preceding abstract. Deductions have been developed from theory of rectification in a.c. silent discharges in semiozonizers (or Maze counters) to account for the sign of rectification and effect of pressure, interelectrode distance, applied potential, supply frequency and temperature. These effects have been experimentally investigated and are shown to be in good agreement with the deductions from theory. Importance of the activated layer, formed on inner surface of glass cylinder in the semiozonizer, in positive wire corona mechanism has been stressed. A.

537.525

2272. MOVING STRIATIONS IN LOW PRESSURE MERCURY VAPOUR. K.W.H.Foulds.
J. Electronics, Vol. 2, No. 3, 270-8 (Nov., 1956).

Fluctuations of the emitted light intensity from a gaseous discharge through low-pressure mercury vapour occur over a range of discharge current which depends upon the saturation vapour pressure of the mercury. These fluctuations in the light intensity have been examined with photocells and are shown to be the result of the interaction of two kinds of moving striations, almost regular striations moving towards the cathode (positive striations) and irregular striations moving towards the anode (negative striations). A.

537.525

2273. MICROWAVE STUDIES OF THE ELECTRON LOSS PROCESSES IN GASEOUS DISCHARGES. R.F.Whitmer.
Phys. Rev., Vol. 104, No. 3, 572-5 (Nov. 1, 1956).

A method for studying electron loss processes in gaseous discharges by means of the free transmission of microwave signals through the discharge is discussed. This method has the advantage that it is easily adaptable to any size or shape of discharge tube. The electron loss processes in pure hydrogen have been studied using this method. For electron densities of $5 \times 10^{13}\,cm^{-3}$, the electron-ion recombination coefficient has been found to be approximately $5.9 \times 10^{-11}\,cm^{-3}\,sec^{-1}$. An electron—neutral collision frequency of $3.97 \times 10^{9}\,sec^{-1}$ at a pressure of 0.29 mm Hg has been measured. The dominant loss process proved to be attachment, with a probability of attachment of approximately 3×10^{-6}. A.

537.525

2274. ON THE THEORY OF PLASMA WAVES. F.Berz.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 939-52 (Sept., 1956).

This theory applies to plasmas with arbitrary stationary electron velocity distributions, neglecting the collisions of electrons with charged or neutral particles. The plasma waves can be divided into two groups. In the first group are the waves which depend on the conditions of excitation. These waves are damped and can have, under suitable initial conditions, any frequency, wavelength and damping, within certain conditions. In the second group are the "proper" plasma waves, i.e. the waves whose dispersion characteristics are not influenced by the initial conditions, but are solely determined by the stationary electron density and the stationary electron velocity distribution f_0 of the plasma. They include the whole class, if any, of amplified plasma waves, and also some definite types of damped and undamped waves. The amplified plasma waves can exist only for special types of electron velocity distributions. "Proper" damped or undamped plasma waves always arise, whatever the initial conditions at $t = 0$. The oscillating velocity distribution for these waves has two components, one which varies in space and time as the electric field, and the other which is carried along with the electrons. For electron distributions f_0 of the Maxwellian type, all the plasma waves are damped, except for $\omega \cong \omega_0$, where $\omega_0 = (4\pi\, ne^2/m)^{1/2}$. This damping is due to the intrinsic properties of the plasma. For $\omega_0 < \omega < 1.05\omega_0$ the damping of the "proper" plasma waves is small, and the corresponding wavelengths cover a wide range $30\lambda_D < \lambda < \infty$ (λ_D = Debye length). The damping becomes large for $\omega > 1.15\omega_0$, $\lambda < 20\lambda_D$. Langmuir's simplified theory gives a good first approximation ($\omega = \omega_0$, λ arbitrary) to these results. In the well-known theory of Bohm and Gross no initial conditions are taken into account, and it is assumed that the oscillating density distribution has no component $\bar{f}^*$ carried along with the electrons. Their dispersion equation is identical with the general dispersion relation for amplified waves, but for non-amplified or damped waves it would correspond to special conditions of excitation. Contrary to the conclusions of Bohm and Gross this equation has no solutions, except for waves which propagate faster than any electron. In all other cases plasma waves can exist only if there is a component $\bar{f}^*$. A.

537.525.3/.4

2275. ON A REGULARITY IN THE TRANSITION OF UNIPOLAR CORONA INTO SPARK DISCHARGE. N.N.Tikhodeev.
Zh. tekh. Fiz., Vol. 26, No. 7, 1493-6 (1956). In Russian.

In systems of electrodes with nonuniform electrostatic field, or where there is strong curvature of one of the electrodes, spark discharge is preceded by a unipole corona. Experiments are described for geometrically similar systems of electrodes. There is found to be a noteworthy constancy in the ratio of the spark voltage to that of the initiating corona. No explanation on theoretical grounds is advanced. The reasons why the Meek—Loeb criteria are not applicable to the transition from corona to spark discharge are discussed. C.R.S.Manders

537.525.3

2276. WERNER'S EQUATION FOR LOW FREQUENCY SILENT ELECTRIC DISCHARGE IN HYDROGEN. D.P.Jatar.
J. chem. Phys., Vol. 24, No. 6, 1273-4 (June, 1956).

Compares experimental data obtained with ozonizer tube (a.c. corona) discharges in hydrogen with the theoretical work of Werner, which originally had special reference to Geiger counter mechanisms. The equation relates operating voltage, starting voltage, current and other parameters. J.D.Craggs

537.525.3

2277. GENERALIZED SECONDARY ELECTRON EMISSION COEFFICIENT FOR THE LOW FREQUENCY SILENT ELECTRIC DISCHARGE IN AIR. D.P.Jatar and H.D.Sharma.
J. chem. Phys., Vol. 25, No. 3, 593 (Sept., 1956).

Describes certain experiments with electrodeless a.c. corona (ozonizer) tubes. From the measurements, values for the generalized Townsend secondary ionization coefficients were deduced. Data are given for air (p.d. up to 125 mm x cm, and $\bar{X}/p$ about 50-200 $V\,cm^{-1}\,mm^{-1}$. J.D.Craggs

537.525.5

2278. THE CROSS-SECTIONS OF NEUTRAL HYDROGEN, HELIUM AND ARGON ATOMS FOR ELECTRON IMPACT. H.W.Drawin.
Z. Phys., Vol. 146, No. 3, 295-313 (1956). In German.

The conductivity equations of a plasma contain cross-section terms; one of these is the electron impact cross-section which may be derived if all the other involved quantities can be measured. The paper fully describes the measurement of the required quantities for stabilized arcs (currents up to about 16 A, pressures up to 0.85 atmosphere). For example in hydrogen, $Q_0^H = 2.2_4 \times 10^{-14}\,cm^2 \pm 35\%$ for temperatures of 7000-11 000°K. In argon, $Q_0^A = 2.5 \times 10^{-16}\,cm^2$ for a similar temperature range, to be compared with the Ramsauer—Kollath value of $1\text{-}3 \times 10^{-18}\,cm^2$. J.D.Craggs

537.525.8

2279. MOVING STRIATIONS IN DIRECT CURRENT GLOW DISCHARGES. H.S.Robertson.
Phys. Rev., Vol. 105, No. 2, 368-77 (Jan. 15, 1956).

A theoretical examination of the ion balance equations for a plasma, such as the positive column of a direct current glow discharge might be, shows that a uniform plasma is not always possible. When ionization proceeds by a two-stage process involving accumulated metastable excited atoms, as may be the case in the noble gases, small perturbations of the ion concentrations from their equilibrium values may not remain small. Under such conditions, a spatially uniform steady plasma cannot exist. A general stability criterion is developed which may be used whenever accurate expressions are known for the ion and metastable production and loss rate terms. Application of the stability criterion is made using several approximations. The instability of a spatially uniform plasma suggests that the ion concentrations may vary along the direction of current flow. The ion balance equations are re-examined for wave-like solutions. Two approximate solutions showing some agreement with experimental observations on moving striations are obtained. The first solution, ignoring variations in the metastable concentration, yields ion and electron concentration waves travelling in the direction of the current flow with velocity probably considerably greater than the positive ion drift velocity. The amplitude of the positive ion wave is much greater than that associated with the electrons. The second approximate solution ignores diffusion and represents a concentration wave dependent solely upon production and loss processes. It can travel in either direction, depending upon conditions in the plasma. General expressions for velocity, frequency, and wave number are given, but these cannot be evaluated numerically without better expressions for some of the quantities involved. A.

537.525.8

2280. THE SUPERPOSITION OF CATHODE SECONDARY AND PHOTOEMISSION IN LOW-PRESSURE DISCHARGES. W.Kluge and A.Schulz.
Z. Phys., Vol. 146, No. 3, 314-19 (1956). In German.

An experimental study of secondary emission processes occurring at silver–caesium oxide cathodes. Photoemission, caused by radiation external to the discharge, was studied separately from the γ-processes due to the latter, with time resolution. It was concluded that the active centres operative in both processes were the same. J.D.Craggs

537.525.8

2281. A FILIFORM ANODE IN A GAS DISCHARGE. B.N.Klyarfel'd and A.A.Frid.
Zh. tekh. Fiz., Vol. 26, No. 11, 2541-7 (1956). In Russian.

A thin wire as an auxiliary electrode extending over the whole length of a long discharge tube and kept positive with respect to cathode sets up a luminous discharge and initiates discharge between main electrodes. A short length of the wire near cathode becomes the anode of an independent discharge, the remainder of the wire collecting electrons from the independent discharge space which, however, carry out multiple orbital movements between wire and wall before arriving at the wire. Electrical Research Association

537.527

2282. ON THE INTERPRETATION OF PRE-BREAKDOWN CURRENTS IN THE COMPRESSED GASES WITH THE AID OF THE SCHOTTKY PHENOMENON. A.Boulloud.
J. Phys. Radium, Vol. 17, No. 6, 21S-22S (June, 1956). In French.

Curves of (log i, $\sqrt{E}$) (i = the current, E = the electric field) are plotted from measurements of the currents flowing between plates of 10 cm^2 area, separated by a few tenths of a mm, in air, at a pressure of ~ 50 atm, when subjected to fields in the range 2×10^5 to 1.2×10^6 V/cm. These results are discussed in terms of the Schottky theory, and other results are quoted to show that an adiabatic expansion gives a change in the current of the same order as that predicted by the theory. J.Dutton

537.527.5

2283. EXAMINATION OF MAGNETIC-FIELD-STABILIZED LONG XENON HIGH-PRESSURE ARCS OF LOW POWER. A.Bauer and P.Schulz.
Z. Phys., Vol. 146, No. 3, 339-49 (1956). In German.

An experimental investigation of the light intensity J emitted per unit length of the column from such arcs at pressures from 25 to 50 atm and with currents i in the range 1 to 6 A. It is shown that $J \propto L^{1.63}$ (where L is the power per unit length of the column), and that $J \propto i^n$ (where $n = 1.82 - 0.1\,p$, and p is the pressure in atmospheres). The current densities in the arcs are estimated from photographic measurements of the cross-sections which are approximately elliptical in shape. The effects of adding He and H_2 are noted. J.Dutton

537.528

2284. RELATION BETWEEN THE PRESSURE AT FRONT OF THE SHOCK WAVE AND THE STEEPNESS OF THE FRONT OF THE ENERGY PULSE IN AN ELECTRIC DISCHARGE IN A LIQUID. A.S.Zingerman.
Zh. tekh. Fiz., Vol. 26, No. 11, 2539-40 (1956). In Russian.

The energy pulse has in many cases exponential form and may for convenience of analytical treatment be replaced by a broken linear plot. Introduced into Drabkina's formula for the pressure-energy relation, this enables the pressure set up by shock waves of the same energy and duration, but different front steepness, to be compared. A difficulty arising from the indeterminacy of the adiabatic exponent is overcome by an extrapolation.
Electrical Research Association

537.529 : 537.312.5 : 537.311.33

EFFECT OF BREAKDOWN ON CONDUCTIVITY OF CdS.
See Abstr. 2215

X-RAYS 537.531

537.531

2285. "CONTINUOUS" INTENSITIES IN THE SOFT X-RAY REGION. R.Noble and L.Jacob.
Nature (London), Vol. 178, 814 (Oct. 13, 1956).

Evidence is given that the intensity relation $I = kZV^2$ breaks down at low tube voltages, and that the slope of the log I–log V relation is about 1.15 for V in the range 200 to 8000 volts. A.R.Stokes

537.531 : 535.3 : 537.311.33

2286. ABSORPTION AND EMISSION SPECTRA OF SILICON AND GERMANIUM IN THE SOFT X-RAY REGION. D.H.Tomboulian and D.E.Bedo.
Phys. Rev., Vol. 104, No. 3, 590-7 (Nov. 1, 1956).

The absorption spectra of thin evaporated foils of Si and Ge have been investigated in the soft X-ray region extending from 70 A to 200 A. The thickness of the various absorbers ranged from several hundred to several thousand angstroms. The spectral region covers the $L_{2,3}$ and $M_{2,3}$ absorption discontinuities of Si and Ge respectively. The $L_{2,3}$ edge of Si appears at 123 A, while the $M_{2,3}$ edge of Ge is centred at 101.5 A. The linear absorption coefficients on the high-energy side of the respective edges of Si and Ge are 1.4×10^5 cm^{-1} and 1.8×10^5 cm^{-1}. The emission spectrum of a Ge target was also studied in the 60 A to 600 A region. Two bands, whose peaks fall at 102.4 A and 104.3 A, have been identified as the M_2 and M_3 emission spectra, corresponding to transitions from the valence band into the M_2 and M_3 levels. With the aid of the present measurements and Skinner's data on the L emission bands of Si, it has been possible to arrive at an estimation of the magnitude of the energy gap in each semiconductor on the basis of the observed interval between emission and absorption edges. The range of forbidden energies as determined by the spectroscopic method is found to be 1.0 eV and 0.8 eV for Si and Ge, respectively. A.

537.531 : 535.43

2287. THEORY OF DIFFUSE X-RAY SCATTERING IN SOLID SOLUTIONS. I. M.A.Krivoglaz.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 625–35 (1956). In Russian.

The intensity of diffuse X-ray scattering in mixed crystals was studied phemonenologically. Thermodynamical quantities, which can be determined from other types of experiments, enter the expressions of the background intensity. Peculiarities of scattering near phase-transition points of the second kind and near critical points on the decomposition curve are investigated. Scattering in weak, ideal and almost completely ordered solid solutions is also considered. A.

537.531.9 : 539.21 : 548.7

2288. THE EFFECT OF U.V. AND X-RAY RADIATION ON SILICATE GLASSES, FUSED SILICA AND QUARTZ CRYSTALS. A.Kats and J.M.Stevels.
Philips Res. Rep., Vol. 11, No. 2, 115-56 (April, 1956).

Glasses, fused silica and quartz crystals are compounds with open structures which favour the occurrence of interstitial cations and anions. A systematic investigation is made of the effect of ultra-violet radiation, X-rays and electrons. The centres thus formed are discussed in terms of the new nomenclature developed recently for open structures. Generally speaking, glasses and quartz crystals behave similarly, whereas fused silica and amethyst have many features in common. A.

CATHODE RAYS. POSITIVE RAYS 537.533/.534

537.533

2289. APPROXIMATIONS FOR LINEAR BETATRON OSCILLATIONS. F.T.Adler and D.Baroncini.
Nuovo Cimento (Ser. 10), Vol. 4, No. 5, 959-74 (Nov., 1956).

Approximation methods for calculating the characteristic exponent of extended Hill equations are derived and applied to the computation of linear betatron oscillations. A.

537.533

2290. INVESTIGATION OF STABILITY OF MOTION OF ELECTRONS IN ORBITAL ACCELERATORS TAKING INTO ACCOUNT QUANTUM EFFECTS. A.A.Sokolov, I.M.Ternov and G.M.Strakhovskiĭ.

The general case of motion of electrons in an orbital accelerator when axial as well as radial oscillations are possible. It is shown that quantum effects can be taken into account by quantizing the adiabatic invariants by the Bohr–Sommerfeld method. The effect of quantum fluctuations on radial-phase oscillations in a synchrotron have also been investigated. In conclusion, the problem of quantum excitation of macroscopic oscillations is discussed. A.

537.533.2

2291. STUDY OF THE AUTO-EMISSION OF ELECTRONS BY NICKEL. G.V.Spivak and A.Gel'berg.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 455-8 (1954). In Russian.

The topic has been studied earlier by Müller (E.Müller, Z. Phys., Vol. 106, 541, 1937; Vol. 108, 668, 1938) and by Tsarev (B.M.Tsarev, Uspekhi fiz. Nauk, Vol. 36, No. 2, 181, 1948) but the present authors introduce refinements and go further in: (a) studying the effect of H on the Ni particle, (b) studying the change of the auto-emission of Ni when passing through the Curie point, (c) measuring the angular distribution of current density of a heated Ni single crystal. Comparison of results with the theory of Stranski and Suhrmann (Abstr. 1576/1948) shows divergences. C.R.S.Manders

537.533.3

2292. THE RADIUS OF CURVATURE METHOD FOR CONSTRUCTION OF SPACE TRAJECTORIES OF CHARGED PARTICLES IN ELECTROSTATIC FIELDS. N.I.Shtepa.
Zh. tekh. Fiz., Vol. 26, No. 10, 2281-6 (1956). In Russian.

537.533.332

2293. MAGNETIC ELECTRON LENSES: SIMPLE GENERAL EXPRESSIONS FOR THE AXIAL FIELD AND THE ELECTRON-OPTICAL CHARACTERISTICS. P.Durandeau.
J. Phys. Radium, Vol. 17, No. 6, 33S-35S (June, 1956). In French.

For symmetrical lenses it is convenient to express parameters in terms of $\sqrt{(S^2+0.45D^2)}$, where S is the gap in the iron circuit and D is the bore. R.Reed

537.533.332

2294. A MATHEMATICAL FIELD MODEL FOR A PERMANENT MAGNET "UNIPOTENTIAL" ELECTRON LENS. F. Lenz.
Z. angew. Phys., Vol. 8, No. 10, 492-6 (1956). In German.

A magnetic analogue of the electrostatic "unipotential" lens is proposed, in permanent magnet form, i.e. a series of three magnetic elements (with or without polepieces) with the central one of opposite polarity to the outer two. The field along the axis can be closely approximated by the expression $B(z) = C\,z/(1 + z^4/a^4)$, for which the differential equations of the ray path can be directly solved. The optical constants of the lens have been evaluated in this way and are given in graphical form. The results are applicable also to "rotation-free" lenses that are excited by windings in the usual way. V.E.Cosslett

537.533.35

2295. PROGRESS OF RESEARCH IN REFLECTION ELECTRON MICROSCOPY. C.Fert.
J. Phys. Radium, Vol. 17, No. 6, 32 S-33 S (June, 1956). In French.

The various methods of reflection electron microscopy are described. Image distortion, due to the inclination of the specimen, is reduced by (1) widening the angle of observation, though this leads to long exposure times, (2) using a spherocylindrical electrostatic correcting lens. Resolution is still limited by the chromatic aberration of the objective and improvements, e.g. grazing incidence, short focal lengths, are being investigated. R.Reed

537.533.35

2296. ON THE THEORY OF THE "AUFLICHT" REFLECTION ELECTRON MICROSCOPE. D.Wiskott.
Optik, Vol. 13, No. 10, 463-78 (1956). In German.

Describes a reflection microscope in which electrons are directed perpendicularly towards a nearly flat conducting surface which serves as object. The surface is kept below cathode potential, so that the electrons are reflected from an equipotential slightly in front of it. Asperities and grooves in the surface distort the reflecting equipotential, so that the reflected electrons, separated from the incident beam by a magnetic deflector, form an image of the surface on a fluorescent screen. The theory of this imaging is developed and found to agree with experiment. A.E.I. Research Laboratory

537.533.35 : 621.385.833

2297. AN EMISSION ELECTRON MICROSCOPE FOR RESEARCH AT HIGH TEMPERATURES. G.Baas and G.W.Rathenau.
Philips tech. Rev., Vol. 18, No. 1, 1-10 (June, 1956-57).

The microscope is designed for imaging the surface of a metal at high temperature (up to 1000°C), the thermionically-emitted electrons being focused by an electrostatic immersion lens and two magnetic projector lenses. The maximum direct magnification is 3000 times, at an accelerating voltage of 45 kV; a resolving power better than 1000 A is obtained. In its main features the microscope, which is in commercial production, resembles the Philips transmission electron microscope, model EM 75 (Abstr. 802 B/1956, Philips tech. Rev., Vol. 17, No. 2, 47-59, Aug., 1955-56). Activators, such as Ba or Cs are evaporated on to the metal surface, in situ, to give adequate thermionic emission at the temperatures at which changes of metallurgical interest are to be investigated. Some of the applications have already been described by G.Baas (Philips tech. Rev., Vol. 16, No. 11, 337-9, May, 1955). V.E.Cosslett

537.533.71

2298. DISCRETE ENERGY LOSSES OF ELECTRONS AT REFLECTION FROM MoO_2 SURFACE. N.B.Gornyĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 1 (7), 132-4 (1956). In Russian.

These were measured at 400°C for different energies of incident electrons by the method of electrical differentiation. It is shown, that the experimental values for the energy losses agree with those calculated from the formula: $W = (h^2/8\pi^2 m)(\pi n/d)^2$, where n/d is determined by the crystal lattice structure and m is the electron mass. Z. Krasucki

537.533.73

2299. ELECTRON INTERFERENCE EXPERIMENTS. J.A.Simpson.
Rev. mod. Phys., Vol. 28, No. 3, 254-60 (July, 1956).

Reviews the history of experimental work on electron interference effects, including crystalline diffraction, Fresnel diffraction at an edge, and interferometers of both the "wavefront splitting" and "amplitude splitting" types. Anomalies in the details of the edge fringes are noted. J.M.Cassels

537.533.73

2300. THEORY OF ELECTRON INTERFERENCE EXPERIMENTS. D.Gabor.
Rev. mod. Phys., Vol. 28, No. 3, 260-76 (July, 1956).

Reviews the theory with particular reference to the limitations on the order of interference set by geometrical factors, finite "train-lengths" (not applicable in some instruments), and energy shifts. It is shown that details smaller than 1 A cannot be explored without destroying the object. J.M.Cassels

537.533.74

2301. POLARIZATION EFFECTS IN THE MØLLER SCATTERING OF ELECTRONS. C.Bouchiat and L.Michel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 642-5 (Aug. 13, 1956). In French.

The covariant formalism of Michel and Wightman (Phys. Rev., Vol. 98, 1190, 1955) for the polarization of spin-$\frac{1}{2}$ particles is applied to the Møller scattering of unpolarized electrons. The only effect found is a correlation between the final spins of the colliding particles. Suggestions are made for observing this. J.S.Bell

537.533.74

2302. DISPERSION CONTRIBUTION TO HIGH–ENERGY ELECTRON–DEUTERON SCATTERING. H.S.Valk and B.J.Malenka.
Phys. Rev., Vol. 104, No. 3, 800-4 (Nov. 1, 1956).

An attempt is made to estimate the contribution of the intermediate nuclear virtual states to the high-energy electron elastic scattering cross-section in the special case of the deuteron. A method is developed by which the nuclear excited states can be approximated by suitably modified free-nucleon wave-functions in the sum over intermediate states. Expressions for the contribution to the cross-section arising from the cross terms between the first (in e^2) and second-order terms of the scattering amplitude are obtained and some numerical results are presented. Some disagreement with previous assumptions as to the magnitude of the "true" dispersion correction is indicated. A.

537.533.74

2303. ABSOLUTE CROSS SECTION FOR ELECTRON SCATTERING FROM PROTONS. R.W.McAllister.
Phys. Rev., Vol. 104, No. 5, 1494 (Dec. 1, 1956).

By comparing the absolute value with the theoretical formula, which contains corrections for the magnetic moment scattering and radiative corrections, a value of 0.75×10^{-13} cm is obtained for the r.m.s. charge radius. G.E.Brown

537.533.74

2304. ANALYTICAL REPRESENTATION OF HARTREE POTENTIALS AND ELECTRON SCATTERING. W.J.Byatt.
Phys. Rev., Vol. 104, No. 5, 1298-300 (Dec. 1, 1956).

Analytical fits to the Hartree curves of 19 neutral atoms are presented. These are in the form of either Wentzel potentials, for lighter elements, or a series of Wentzel-like terms, for heavier elements. Applications to the scattering of electrons by atoms are briefly discussed. Among the principal results is an iteration method which yields expressions, in terms of tabulated integrals, for the radial eigenfunctions for a particle scattered by a Wentzel potential. A.

537.533.74

2305. EXPERIMENTS ON LOW-ENERGY ELECTRON SCATTERING AND ENERGY LOSSES. L.Marton.
Rev. mod. Phys., Vol. 28, No. 3, 172-83 (July, 1956).

Reviews work on the interaction of low energy electrons i.e. those with energy less than the rest energy of the electron, mainly with solids. Practically electrons of energy from 10^2 to 5×10^4 eV are considered. Topics discussed are: elastic and inelastic scattering, chemical structure and its effect on scattering, energy losses in relation to effects produced in the scattering medium such as optical transitions, chemical binding and characteristic energy loss, angular distribution of scattered electrons, interactions with gases and vapours. The principles of the experiments rather than detailed techniques are described. (57 references). C.A.Hogarth

537.533.74

2306. THEORY OF THE SCATTERING OF SLOW ELECTRONS. H.S.W.Massey.
Rev. mod. Phys., Vol. 28, No. 3, 199-213 (July, 1956).

Techniques involved in the various two-state approximations are summarized. Allowance for intermediate states is discussed. A detailed review of the applications is given, with particular emphasis on scattering by hydrogen and helium, and including a description of the variational methods commonly employed. The effects encountered in close-coupling situations are discussed, the methods employed are described, and the results reviewed. It is concluded that the weak-coupling two-state approximation is often satisfactory, provided that full allowance is made for distortion by the mean potential fields and by the exchange interaction. In certain broadly specified cases the coupling cannot be regarded as weak and the methods must be refined. The importance of polarization effects is not yet clear, although they seem to be mainly apparent in small-angle elastic scattering, and to a lesser extent in inelastic collisions involving optically-allowed transitions. N.M.King

537.533.74

2307. RADIATIVE CORRECTIONS FOR ELECTRONS SCATTERED BY ELECTRONS OR POSITRONS. R.V.Polovin.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 449-58 (1956). In Russian.

The general and the high-energy cases are studied. Radiative corrections for electrons scattered by electrons or positrons are calculated with an accuracy to α^3. A.

537.533.75

2308. ORIGIN OF THE CHARACTERISTIC ENERGY LOSSES OF ELECTRONS IN SOLIDS. E.J.Sternglass.
Nature (London), Vol. 178, 1387-9 (Dec. 22, 1956).

An explanation is proposed of the characteristic energy losses of electrons passing through thin foils in terms of the ionization of the bound shell next to the valence level (binding energy 10 to 20 eV), together with excitations and ionizations of the valence electrons. The losses of higher energies are explained as simple combinations of the fundamental processes, using simple probability considerations. The Bohr–Bethe theory for the stopping of charged particles is used to calculate the expected number of collisions in a given path length. The calculated loss spectra for aluminium are in good agreement with experiment. The theory is compared with the alternative explanation in terms of plasma oscillations. E.H.Sondheimer

537.533.75

2309. ON THE SOLUTIONS OF THE FLUCTUATION PROBLEM IN CASCADE SHOWERS. H.Messel.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1339-48 (Dec., 1956).

A practical method of obtaining numerical results in special cases for the number distribution function in shower theory is considered. It is also shown that Lopuszanski's and Moyal's recent solutions of the number distribution function equations are only formal expansions of these functions in terms of factorial moments. A.

537.533.75

2310. ENERGY LOSS AND STRAGGLING OF 150-MeV ELECTRONS IN Li, Be, C, AND Al. A.M.Hudson.
Phys. Rev., Vol. 105, No. 1, 1-6 (Jan. 1, 1957).

The most probable energy loss and the straggling distribution for 150 MeV electrons in thin targets (~ 2.5 g/cm^2) of Li, Be, C and Al have been measured utilizing the electron beam of a linear electron accelerator. The primary beam energy spectrum had a full width at half-height of 0.20 MeV. The data for the most probable energy loss agree with the theory of Landau when corrected for the density effect according to Sternheimer. A recent recalculation of this density effect on the basis of new values for the mean excitation potentials after Caldwell noticeably improves agreement between theory and experiment for carbon. Comparison is made with calculations using Bakker and Segrè potentials. The half-widths of the straggling distributions are between 7 and 15% wider than the Landau theory predicts, in qualitative agreement with a recent comment by Hines. A.

537.533.75

2311. AN EXPERIMENTAL INVESTIGATION OF CHARACTERISTIC ELECTRON ENERGY LOSSES IN SOLIDS. G.W.Jull.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1237-48 (Dec., 1956).

The characteristic electron energy losses in a number of materials have been studied experimentally, with a view to elucidating their origin. The sharp losses of 14.6 eV in Al and 10.0 eV in Mg do not appear in their oxide spectra, while the broad bands in Be and Si are similar to those of their oxides. The mean free path for the 14.6 eV loss process in Al was found to be 260 A for 10 keV electrons. This strong line is weakened by preparing the film in a number of thin layers, of 20-50 A each, isolated from one another by some foreign material. This observation suggests that the 14.6 eV loss may well be due to collective excitation, and that boundary layers play an important role in determining the intensity of characteristic losses. A.

537.533.79

2312. INVESTIGATION OF THE STATES OF AN ELECTRON IN A PROPOSED ELECTROMAGNETIC FIELD. E.van der Spuy.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1349-63 (Dec., 1956).

This investigation discusses, in terms of quantum mechanics, the polarization of a beam of electrons in a proposed experiment which is a modification of the Rabi type of radiofrequency spectroscopy experiment. The level structure of the electron in the uniform field and its discrimination in the inhomogeneous fields, as well a the stimulated transitions in the uniform field, is discussed essentially in quantal terms. A.

537.533.8

2313. EFFECTIVE DEPTH OF SECONDARY ELECTRON EMISSION. N.D.Morgulis and N.G.Nakhodkin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1029-32 (1954). In Russian.

The secondary electron emission efficiency (δ) of a number of metals and semiconductors was measured as a function of thickness (z) (by preparing the cathode in the shape of a wedge) and of primary electron energy (V_p) in the range 200 to 3000 eV. The efficiency δ becomes constant at a value of z which is independent of V_p. This value of z is taken to be the effective depth of secondary emission. Values vary from about 10 mμ for metals to 100 mμ or more for semiconductors. For some metals a second plateau in the δ/z curve was observed at about 50 mμ. The value of the efficiency goes through a maximum as V_p is increased. Explanations of the effects are offered. J.B.Arthur

537.533.8

2314. INVESTIGATION OF THE ANGULAR DISTRIBUTION OF SECONDARY ELECTRONS FROM CUPROUS OXIDE AND THEIR DISTRIBUTION IN ENERGY. N.B.Gornyĭ.
Zh. éksper. teor Fiz., Vol. 31, No. 3(9), 386-92 (1956). In Russian.

The yield of secondary electrons at various angles was studied in a vacuum apparatus containing a spherical collector divided into a set of belts. Pronounced maxima were found in the experimental secondary-electron angular-distribution curves at large angles ($\sim 60^0$). It is shown that the experimental results are distorted by secondary electrons emitted from the collector (tertiary electrons). A method of applying corrections for this distortion is presented. The corrected secondary-electron angular-distribution curve satisfactorily agrees with the cosine law. An electric differentiation technique was used to investigate the energy distribution of secondary electrons emitted at various angles. A.

537.533.8

2315. SECONDARY ELECTRON EMISSION OF COPPER, GERMANIUM AND TIN IN SOLID AND LIQUID STATES. V.G.Bol'shov and V.K. Seleznev.
Zh. tekh. Fiz., Vol. 26, No. 8, 1657-64 (1956). In Russian.

Specially constructed vacuum apparatus and an experimental technique are described for measuring secondary emmision coefficient σ of Cu, Ge and Sn. It is shown that with an increase from room temperature to 232°C for Sn and to 1033°C for Cu σ_{max} does not alter by more than 1%; for Ge σ_{max} drops by 5-6% up to 959°C. The changes in σ due to energy levels U_p of primary electrons from 100 to 1500 eV are investigated next; at the melting point and U_{pmax} $\sigma_{liquid} > \sigma_{solid}$ by 5% in the case of Cu, by 14% for Sn and by 9% for Ge. An additional study is made of the distribution of secondary electrons at different energy levels for Sn. Numerous characteristics and oscillograms are reproduced, and an international bibliography is quoted. A.Landman

537.533.8

2316. BREMSSTRAHLUNG POLARIZATION MEASUREMENTS FOR 1.0 MeV ELECTRONS. J.W.Motz.
Phys. Rev., Vol. 104, No. 3, 557-62 (Nov. 1, 1956).

With 1 MeV electrons incident on thin aluminium and gold targets, bremsstrahlung polarization as a function of photon energy for a 20° emission angle has been measured with a polarimeter that depends on the polarization sensitivity of the Compton process. The selection of energy intervals out of the continuous bremsstrahlung spectrum was accomplished by employing the polarimeter as a double crystal Compton spectrometer. The results show a polarization reversal in qualitative agreement with the Born approximation calculations of Gluckstern and Hull. With the gold target, the polarization reversal occurs at a lower photon energy than that predicted by the Born approximation theory. Such a shift in the reversal energy is obtained with the Born approximation theory for a lower initial electron energy. A.

537.533.8

2317. COMPUTATIONS OF NONRELATIVISTIC ELECTRON BREMSSTRAHLUNG. J.M.Berger.
Phys. Rev., Vol. 105, No. 1, 35-8 (Jan. 1, 1956).

Highly accurate computations of the total intensity of bremsstrahlung have been performed on the UNIVAC using both Sommerfeld's result and the Born approximation as modified by Elwert. The incident electron energy range treated was from 0.44 eV to 80 keV, together with a large range of emergent electron energies so as to cover the range of emitted frequencies. The results are presented graphically such that they may be obtained to an accuracy of better than 1.0%. A.

537.533.9

2318. EXPERIMENTAL STUDIES OF POSITRON INTERACTIONS IN SOLIDS AND LIQUIDS. S.Berko and F.L.Hereford.
Rev. mod. Phys., Vol. 28, No. 3, 299-307 (July, 1956).

A review discussing the following topics: positron annihilation processes, time distribution of the annihilation in liquids and solids, three-photon and two-photon annihilation rates, two-photon angular correlation. 34 references. E.P.Wohlfarth

537.533.9

2319. THEORY OF POSITRON ANNIHILATION IN SOLIDS. R.A.Ferrell.
Rev. mod. Phys., Vol. 28, No. 3, 308-37 (July, 1956).

A review discussing the following topics: processes in ionic crystals (non-formation of positronium due to electron, positron or positronium affinity, two-photon angular correlation); metals (two-photon angular correlation and causes for deviations from an ideal parabolic correlation curve, lifetime, Coulomb interaction effects, relation to X-ray emission); insulators (lifetime, temperature effect, narrow component in two-photon angular correlation). 75 references. E.P.Wohlfarth

537.533.9

2320. POLARIZATION EFFECTS IN THE RADIATION EMITTED BY THE RADIATING ELECTRON. A.A.Sokolov and I.M.Ternov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 473-8 (1956). In Russian.

Polarization effects in the radiation from a radiating electron have been studied by quantum methods in the classical approximation. The formulae thus obtained apply to linear as well as circular polarization. A.

537.533.9

2321. ROLE OF SPIN ON THE RADIATION FROM THE "RADIATING ELECTRON". A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 479-89 (1956). In Russian.

It is shown that at not very high energies the spin corrections are second-order quantities with respect to quantum corrections; at high relativistic energies, however, the spin appreciably affects the shape of the differential spectrum and magnitude of the total energy of the radiation. A.

537.534

2322. TRITIUM RESERVOIR WITH LOW OUTPUT SUITABLE FOR USE ON A VAN DE GRAAFF GENERATOR. D.Magnac-Valette and M.Liess.
J. Phys. Radium, Vol. 17, No. 5, 449-50 (May, 1956). In French.

The reservoir described is of 25 cm^3 capacity, and enables quantities of about 1 cm^3 of tritium gas to be used efficiently (without excessive dilution) in arc ion source. J.J.Wilkins

537.534 : 518.5 : 621.372.2 : 621.384.6

2323. CALCULATOR FOR SOME R.F. PROBLEMS IN ACCELERATOR DESIGN. K.R.MacKenzie.
Rev. sci. Instrum., Vol. 27, No. 8, 580-3 (Aug., 1956).

A simple mechanical calculator has been developed for solving the transmission line equations when the characteristic impedance is a variable. The speed of computation is some two orders of magnitude faster than analytical methods. The theoretical basis is described and also the way in which it can be used. Some representative problems, which have benefited by use of the calculator, are discussed. A.

537.534

2324. THEORY OF COMPENSATION OF ION BEAMS. V.S.Anastasevich.
Zh. tekh. Fiz., Vol. 26, No. 7, 1487-92 (1956). In Russian.

The author draws attention to the important part played by the secondary ions in processes of compensation and decompensation arising in a gas discharge. The first half of the paper considered the theoretical aspects of the theory of compensation of the space charge due to ion beams for stationary conditions, i.e. where the primary ion current does not vary with time. It is pointed out that the current theory takes no account of the possibility of an electric field arising as a result of temperature fluctuations outside the beam plasma. For very high currents and energies of primary ions the effects of self-focusing of the beam ought to be taken into account. The second half of the paper considers processes in non-stationary conditions and it is concluded that these processes can only be correctly understood and described with an examination of the process of accumulation of the secondary ions and their motion out of the beam. The author has solved the relevant equations for moderate values of the primary ion density. C.R.S.Manders

537.534.3

2325. CHART FOR SOLUTION OF A PROBLEM WITH ELECTRIC OR MAGNETIC ALTERNATING GRADIENT LENSES. P.Lévy.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 60A-61A (June, 1956). In French.

A chart is described aiding in selection of parameters for an alternating-gradient focusing channel, for the case where focusing takes place at the same point in both planes. The chart has been used in designing an electrostatic lens for the beam from an accelerator ion source. N.M.King

537.534.3

2326. BROAD-RANGE MAGNETIC SPECTROGRAPH. C.P.Browne and W.W.Buechner.
Rev. sci. Instrum., Vol. 27, No. 11, 899-907 (Nov., 1956).

A spectrograph for precise measurement of the energies and intensities of charged particles from nuclear reactions is described. A uniform magnetic field with a circular boundary focuses particles from a source outside the field along a hyperbolic focal surface. Particles with energies varying by as much as a factor of 2.5 may be simultaneously recorded on nuclear-track plates. Under routine operating conditions, an energy resolution of better than 1000 is obtained over the length of the focal surface. The design, construction, testing, and operation of the spectrograph are described, and plots of dispersion, magnification, aberration, and calibration are given. A.

537.534.3

2327. NON-MAGNETIC MASS SPECTROMETERS. L.W.Kerr.
J. Electronics, Vol. 2, No. 2, 179-98 (Sept., 1956).

This paper starts both a brief review of non-magnetic mass spectrometers and serves as an introduction. The paper contains a general theory of radiofrequency "energy-gain" mass spectrometers based on a Fourier analysis of the r.f. analyser field. This method allows a fundamental insight into all energy gain analysers, whether periodic or not and shows that the performance of any analyser is dependent only on the effective number of stages N. A comparison is made between the performance of magnetic mass spectrometers and r.f. "energy-gain" instruments. On the assumption of equal ion path lengths, it is shown that contrary to general belief the current efficiency of the r.f. instruments described in the literature is generally rather less than that of the equivalent magnetic types. A discussion is also given of the factors which limit the resolving power of energy-gain mass spectrometers. A.

537.534.3

2328. IMAGE CURVATURE CAUSED BY FRINGING FIELDS IN MAGNETIC SECTOR MASS SPECTROMETERS. G.E.Berry.
Rev. sci. Instrum., Vol. 27, No. 10, 849-53 (Oct., 1956).

The fringing field of a magnetic sector analyser produces a curved image of a line object. This is because rays off the median plane traverse a slightly different fringing field from that traversed by those on the median plane. In this paper, the shape of the image is calculated for a general paraxial ray travelling in a plane inclined to the median plane, under the assumption that the fringing field is two-dimensional. It is found that the image is not only curved, but

is broadened by an amount depending on the exact nature of the fringing field. In the special case in which all paraxial rays travel in planes parallel to the median plane, and in which the analyser is symmetrical, a straight-line object is imaged in a line having a radius of curvature of R/2, where R is the sector radius. In this special case, the shape of the image is independent of the exact nature of the fringing field. A.

537.534.3

2329. HIGH SENSITIVITY MASS SPECTROMETER FOR NOBLE GAS ANALYSIS. J.H.Reynolds.
Rev. sci. Instrum., Vol. 27, No. 11, 928-34 (Nov., 1956).

A high-sensitivity mass spectrometer is described in detail. Ultra-high vacuum techniques have been used throughout so that small rare gas samples can be closed off within the spectrometer envelope and analysed statically. This procedure is of considerable advantage in analysing argon and lighter rare gases. The background spectrum when the spectrometer pressure is 5×10^{-10} mm Hg is described. Sensitivity data are presented. The detectability of the instrument for xenon atoms (any isotope) is 0.5×10^{6} atoms; for A^{36}, the detectability is 14×10^{6} atoms. A.

537.534.74

2330. TOTAL CROSS-SECTION OF THE pd INTERACTION IN THE ENERGY RANGE 390-650 MeV. V.P.Dzhelepov and V.I.Moskalev.
Dokl. Akad. Nauk SSSR, Vol. 110, No. 4, 539-41 (1956). In Russian.

The cross-section is found by measuring the attenuation of a beam of collimated protons by targets of ordinary and heavy water with "good geometry". Both the cross-section σ_{dp} and $(\sigma_d - \sigma_p)$ are measured. G.E.Brown

537.534.74

2331. ALPHA–ALPHA SCATTERING AT LOW ENERGIES. N.P.Heydenburg and G.M.Temmer.
Phys. Rev., Vol. 104, No. 1, 123-34 (Oct. 1, 1956).

The differential cross-section for the scattering of alpha particles in helium was measured between laboratory angles of 10 and 80° and in the energy range 150 keV to 3 MeV, using He^{+} ions from electrostatic generators. Below 400 keV no nuclear interaction occurs within the accuracy of the experiments (± 1%), and Mott's formula for the Coulomb scattering of identical zero-spin particles is verified in detail. Above 400 keV the nuclear s-wave interaction begins to contribute, starting at a phase shift K_0 near π, and smoothly decreasing with increasing energy to about 128° at 3 MeV. Starting at 2.5 MeV, a small d-wave phase-shift, K_2 is found necessary to account for the observed angular distributions, reaching a value of 2.5° at 3 MeV. Absolute values of the cross-sections were determined by fitting the relative angular distributions with the single parameter K_0 below 2 MeV, and by comparison with Rutherford scattering in argon above 2 MeV. The phase-shift analysis was facilitated by a simple mechanical nomograph. A careful survey of the low-energy region containing the ground state of Be^{8}, and the absence of any measurable effect leads to a lower limit for the mean life of the ground state of Be^{8} of 2×10^{-16} sec. Combined with a recently established upper limit of 4×10^{-15} sec, this locates the lifetime to within a factor of twenty. A.

537.534.74

2332. PROTON–PROTON SCATTERING AT 457 MeV IN A BUBBLE CHAMBER. I.A.Pless.
Phys. Rev., Vol. 104, No. 1, 205-10 (Oct. 1, 1956).

Measurements were made with a negative-pressure bubble chamber. The experimental setup, beam, and operation cycle are described. A brief description of the bubble chamber is given and an analysis is made of errors associated with this technique. Total cross-sections for carbon and hydrogen are measured and the data are fitted to an angular distribution which is the sum of the first five even Legendre polynomials. The results are: the total cross-section for carbon is 317 ± 17 millibarns; the total integrated cross-section for hydrogen from 10° to 90° in the centre-of-mass system is 25.8 ± 2.3 millibarns. For angular distribution, 507 events were used to determine a least squares fit to five parameters. The best fit is: $d\sigma/d\Omega = \{4.10 \pm 0.37\}\{(1.032 \pm 0.047)P_0 + (0.402 \pm 0.119)P_2 + (0.149 \pm 0.172)P_4 + (0.198 \pm 0.209)P_6 + (0.507 \pm 0.249)P_8\}$ mb sterad. A.

537.534.74

2333. HIGH-ENERGY PROTON–PROTON SCATTERING AND THE LÉVY POTENTIAL. M.S.Wertheim, M.H.Hull, Jr and A.M.Saperstein.
Phys. Rev., Vol. 104, No. 3, 764-7 (Nov. 1, 1956).

The predictions of Lévy's potential for high-energy proton–proton scattering have been examined. The potential was used in the form of Blatt and Kalos, and contains three adjustable parameters. Values of the parameters that fit the low-energy data as well as values that lead to approximately correct total cross-sections at high energies have been tried. Phase shifts obtained by numerical integration at several energies were used to calculate the cross-section and the polarization. Definite disagreement with experimental results was found. Features of Lévy's potential responsible for the disagreement are discussed. A.

537.534.74

2334. POLARIZATION OF PROTONS ELASTICALLY AND INELASTICALLY SCATTERED IN G5 EMULSION. J.I.Friedman.
Phys. Rev., Vol. 104, No. 3, 794-9 (Nov. 1, 1956).

Measurements have been made of the polarization resulting from both the elastic and inelastic scattering of high-energy protons in Ilford G5 emulsion. The elastic polarization was measured by measuring the azimuthal asymmetry of the elastic scattering in emulsion of 0.64 ± 0.04 polarized, 310 ± 5 MeV protons from a synchrocyclotron. The average polarization resulting from elastic scattering between 3° and 15° in the laboratory system is 0.44 ± 0.13. Emulsion was exposed to a 0.76 ± 0.03 polarized, 316 ± 4 MeV proton beam from another synchrocyclotron for the measurement of polarization due to inelastic scattering. The light prongs of the stars produced in the emulsion show a definite asymmetry. This asymmetry is increased by requiring of the light prongs an angle-energy correlation consistent with quasi-elastic scattering. The data indicate that the polarization decreases with larger prong number stars. From the 304 m of track scanned in the measurement of elastic polarization, data have been collected on the cross-sections of 305 ± 5 MeV protons in G5 emulsion. A.

537.534.74

2335. SCATTERING OF 7.5-MeV PROTONS BY HELIUM. T.M.Putnam, J.E.Brolley,Jr and L.Rosen.
Phys. Rev., Vol. 104, No. 5, 1303-6 (Dec. 1, 1956).

The differential cross-section for the elastic scattering of 7.5 ± 0.1 MeV protons from helium has been measured at 2.5° intervals over the laboratory angular range 10° to 172.5° using the Los Alamos nuclear plate camera. The results obtained have an absolute standard error of ±2.5% to ±3%. A phase-shift analysis of the data gives for the S, P, and D phase shifts: $\delta_0 = -57.95°$, $\delta_1^{+} = 112.1°$, $\delta_1^{-} = 52.51°$, $\delta_2^{+} = 0.44°$, $\delta_2^{-} = -1.87°$. These results fit the experimental data with a root-mean-square deviation of 2.7% and appear to be in harmony with those determined from experiments at other energies. A.

537.534.74

2336. PROTON–PROTON SCATTERING AT 134 MeV. A.E.Taylor and E.Wood.
Proc. Phys. Soc. A, Vol. 69, Pt 8, 645-9 (Aug., 1956).

The differential cross-section for (p,p) at 134 MeV scattering at 90° was determined by proton absorption measurements in liquid hydrogen. Two 1 cm diameter scintillation counters in double coincidence were used to define and monitor the external, unpolarized beam from the 110 in. synchrocyclotron before it passed into a liquid hydrogen target whose transmission was measured by a 17 cm diameter scintillation counter operated in triple coincidence with the two monitoring the incident beam. From the values obtained, the integrated cross-section $_t(\theta)$ for scattering through angles greater than θ was obtained. Values $_t(\theta)$ were obtained for θ (centre-of-mass) in the range 8.4° to 20.9°. From these values and assuming isotropy, the value of the differential cross-section for (p, p) scattering at 134 MeV at 90° was estimated as 3.79 ± 0.13 mb $sterad^{-1}$. Using published data which indicates a deviation from isotropy together with the above work, a value of 3.63 ± 0.15 mb $sterad^{-1}$ was obtained for the differential cross-section at 90°. D.R.Chick

537.534.75 : 539.153

2337. STOPPING POWER AND VALENCE STATES. W.Brandt.
Phys. Rev., Vol. 104, No. 3, 691-3 (Nov. 1, 1956).

Based on the dynamic Thomas–Fermi model of the atom, the Bloch theory of the mean excitation potential, I, predicts that I = KZ, where K is Bloch's adjustable constant and Z the atomic number. Stopping experiments with 340 MeV protons reveal an increase of K for decreasing Z, with superimposed fluctuations. These fluctuations are shown quantitatively to be caused by valence state and polarization effects. For isolated atoms, I/Z increases smoothly with decreasing Z, confirming the Z-dependence of K predicted by Jensen for the dynamic Thomas–Firmi–Dirac model. A.

537.534.75

2338. STOPPING POWER OF VARIOUS GASES FOR LITHIUM IONS OF 100–450-keV KINETIC ENERGY. S.K.Allison and C.S.Littlejohn.

Phys. Rev., Vol. 104, No. 4, 959-61 (Nov. 15, 1956).

The stopping power, expressed in electron volts per atom of gas per square centimetre has been measured in H_2, He, air and argon for lithium ions in the kinetic energy range 100-450 keV. Collisions which would have deviated the lithium ions as much as 10^{-3} radian would have removed them from the detector aperture, so that the measured stopping power arises entirely from electronic collisions. A.

537.534.75 : 778.34

PROTON ENERGY LOSS IN NUCLEAR EMULSIONS. See Abstr. 1832

537.534.8

2339. AUGER EJECTION OF ELECTRONS FROM MOLYBDENUM BY NOBLE GAS IONS. H.D.Hagstrum.
Phys. Rev., Vol. 104, No. 3, 672-83 (Nov. 1, 1956).

Experimental investigation of electron ejection from atomically clean molybdenum by singly- and doubly-charged ions of the noble gases is reported. The basic measurements of electron yield and energy distribution of ejected electrons have been made for ions of kinetic energy in the range 10 to 1000 eV. Measurements are made at bombarding electron energies in the ion source below the threshold for formation of metastable ions. The electron ejection for molybdenum, as previously found for tungsten, has characteristics appropriate to ejection in Auger-type processes of neutralization and de-excitation at the metal surface. Values of 0.300, 0.254, 0.122, 0.069, and 0.022 were obtained for the electron yield for 10 eV He^+, Ne^+, A^+, Kr^+, and Xe^+ ions, respectively. Extensive comparison of the present results with the work of others is possible. Comparison of the results for molybdenum and tungsten shows the differences to be largely attributable to the effect of work function change on the probability of escape of internally excited electrons from the metal. The Ne^+ ion shows the anomalies characteristic of the resonance neutralization and Auger de-excitation of a fraction of the ions at higher ion energies as was found for tungsten. Careful measurements have been made of yield and energy distributions of electrons ejected by doubly-charged ions. The processes by which a doubly-charged ion is de-excited and neutralized at a clean metal surface have been investigated in detail. A.

537.534.8

2340. BOMBARDMENT OF VARIOUS ELEMENTS BY Hg^+ AND A^+ IONS. J.F.Strachan and N.L.Harris.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1148-61 (Nov., 1956).

The sputtering, in low-pressure discharge tubes, of carbon by Hg^+ and A^+ ions at energies from 10 eV to 20 x 10^3 eV was investigated by direct weight-loss measurements. The commonly quoted linear variation of sputtering rate in grammes per ampere-hour held up to 2 to 3 kV, where is was replaced by a variation proportional to $(\text{voltage})^{1/2}$. Sputtering occurred at 30 volts, a value well below the usual "critical voltages" in the literature. X-rays were generated above 8 kV by the action of secondary electrons emitted from the targets. The emission from spherical targets was determined from the dimensions of the positive ion sheaths, and was initially proportional to voltage, after which the rate of increase diminished rapidly. A brief survey of the sputtering of beryllium, aluminium, silicon, iron, nickel, copper, molybdenum, tungsten, lead and uranium indicated similar variations with voltage, and showed that the sputtering rate was roughly proportional to the $(\text{atomic weight of the target})^{1.3}$ and that it increased with the heavier ion. These empirical relations are useful for practical assessments, but not for theoretical interpretation, unless the secondary electron emission is distinguished. This was done for carbon and iron and the sputtering rate in atoms per ion s determined. The empirical relation of the form $s = \lambda \ln(V/V_0)$ was found, where V_0 is thought to be related to the "penetration" of the ion into the target, and has a value of a few hundred volts. The ratio of the binding energy of the atom to the energy required to sputter it, for carbon and iron atoms released by Hg^+ and A^+ ions, had a maximum of 0.5% at 1000 volts for iron. A.

537.534.9

2341. IONIZATION LOSS AND THE RANGE–ENERGY RELATION FOR LOW ENERGY PROTONS IN METALS. K.L.Kaila and N.K.Saha.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 888-93 (Dec., 1956).

In the absence of any precise theoretical treatment of the ionization loss of heavy charged particles at low energies, Bethe's original ionization loss formula has been modified empirically by introducing a multiplying factor $F = (Z_{eff}/Z)\{E^2/(E^2 - E_0^2)\}$ which removes the zero of the logarithm at $2mv^2/I = 1$ and passes to unity at high energy. The modified formula gives results showing reasonably good agreement with the experimental data of Madsen and of Warshaw on the ionization loss of protons in Al, Cu, Ag and Au down to approximately 50 keV and passes on smoothly to Bethe's original formula at medium and high energies. A modified range–energy relation for low-energy protons based on this formula is computed. Range–energy values are calculated from this relation for Al, Cu, Ag and Au. The results for Al and Cu show considerable departure from Livingston and Bethe's curves for protons at low energies. A.

DISCHARGE TUBES. COUNTERS 537.54

537.542

2342. ON THE INFLUENCE OF FLOWING PLASMA ON THE FOCUSING POWER OF AN ION SOURCE. M.D.Gabovich and E.T.Kucherenko.
Zh. tekh. Fiz., Vol. 26, No. 5, 996-1003 (1956). In Russian.

The behaviour of the plasma passing through the output hole of an ion source of protons is investigated with particular regard to its spatial distribution. The gradient of potential assumes values up to 50 V/cm: this is in good agreement with theory. The voltage–current characteristics measured at the extraction point of the beam may be explained if one takes into account the displacements of the plasma. This shows that the ion current is not limited by a space charge effect, as it has been stated by other authors (Abstr. 5885/1950). G.Martelli

537.542

2343. PHOTOIONIZATION AS A SOURCE OF IONS FOR MASS SPECTROMETRY. F.P.Lossing and I.Tanaka.
J. chem. Phys., Vol. 25, No. 5, 1031-4 (Nov., 1956).

Some preliminary experiments are described in which ions are formed in the ionization chamber of a mass spectrometer by radiation from a source of far ultraviolet. Depending on the wavelength of the radiation and the ionization and appearance potentials of parent and fragment ions, it is possible to produce spectra which consist of the parent ion only. In one case a dissociative ionization process was observed. Free methyl radicals from the pyrolysis of mercury dimethyl were also detected by photoionization. Some possible applications of the technique to the measurement of ionization and appearance potentials and to special problems in mass spectrometry are discussed. A.

537.542

2344. ION SOURCE FOR THE PRODUCTION OF MULTIPLY CHARGED HEAVY IONS. C.E.Anderson and K.W.Ehlers.
Rev. sci. Instrum., Vol. 27, No. 10, 809-17 (Oct., 1956).

A pulsed, cold-cathode ion source has been developed to produce multiply-charged ions for use in a linear accelerator. Milliampere currents of such ions as He_4^{2+}, C_{12}^{2+}, N_{14}^{3+}, O_{16}^{3+}, Ne_{20}^{3+}, and smaller currents of S_{32}^{5+} and A_{40}^{6+} have been produced in focused beams. Mass spectra of the various ionization states produced by the arc are presented. Constructional details of the source and the associated electronic equipment are given, and operating characteristic of the source and ion extraction are discussed. A.

537.542

2345. HIGH-CURRENT ION INJECTOR. W.A.S.Lamb and E.J.Lofgren.
Rev. sci. Instrum., Vol. 27, No. 11, 907-9 (Nov., 1956).

An ion injector is described which is capable of continuous currents of protons or deuterons of $\frac{3}{4}$ amp at 100 kV or pulsed currents of 2 amp at a 20% duty cycle. The beam comes to a focus about 3 in. in diameter and diverges at an angle of $\pm 5^0$. It is approximately 95% atomic ions. A.

537.542

2346. THE ARRANGEMENT OF END-WINDOW GEIGER-MÜLLER COUNTERS FOR THE MEASUREMENT OF LOW ENERGY ELECTROMAGNETIC RADIATION. M.Duquesne.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 85 A-89 A (June, 1956). In French.

A detailed analysis of the performance of end-window counters in terms of counter geometry. Such matters as the effect of window absorption and the sensitive volume as a function of absorption coefficient of the radiation are discussed. Experimental verification is given. J.D.Craggs

537.542

2347. DISCHARGE SPREADING IN SELF-QUENCHED COUNTER TUBES. I. E.Huster and E.Ziegler.
Z. Phys., Vol. 146, No. 3, 281-94 (1956). In German.

A detailed experimental investigation was made of discharge

spreading in divided-electrode counter tubes and with two neighbouring tubes with opposing cathode slits. There is a full discussion of the results. J.D.Craggs

537.542 : 548.733

2348. USE OF COUNTER TUBES IN X-RAY ANALYSIS. W.Parrish and T.R.Kohler.
Rev. sci. Instrum., Vol. 27, No. 10, 795-808 (Oct., 1956).

The more important properties of end-window Geiger counters, side-window proportional counters, and NaI(Tl) scintillation counters are reviewed and their performance in the 5 to 50 kVp X-ray analysis region is compared. Proportional and scintillation counters have resolving times of the order of 0.25 μsec and virtually eliminate the non-linearity limitation of the Geiger counter. They produce pulse amplitudes proportional to the energy of the X-ray quanta, and thus simple pulse-height discrimination techniques can be used to obtain greatly improved peak-to-background ratios with little loss of intensity of the characteristic X-rays. They are as reliable and nearly as easy to use as Geiger counters. The electronic discrimination method is described and explained with some practical applications. For a given experimental arrangement, the measured intensity is determined by the quantum counting efficiency of the counter tube, and the peak-to-background ratio is determined by the spectral response of the detector-discriminator combination. A.

537.542

2349. GUARDED-FIELD IONIZATION CHAMBERS: A NEW PRINCIPLE APPLIED TO BOTH FREE-AIR AND THIMBLE VERSIONS. L.A.W.Kemp.
Nature (London), Vol. 178, 1250-1 (Dec. 1, 1956).

The technique of using guard-wires at graded potentials between the parallel plates of a free-air ionization chamber has been advanced by replacing the wires by wider strips, with resulting further improvement in uniformity of the electrostatic field. The guarded-field thimble chamber described has the advantages of geometrical simplicity, symmetry and completely uniform collecting field. D.V.Mabbs

537.542

2350. ELECTRONEGATIVE IMPURITIES IN IONIZATION CHAMBERS. P.F.Little.
J. Electronics, Vol. 2, No. 2, 101-17 (Sept., 1956).

It is shown that in pure oxygen the electron attachment occurring in swarm experiments — taken to be $e + O_2 \rightarrow O + O^-$ — agrees reasonably well with that expected from cross-section observed for mono-energetic electrons if a Maxwellian distribution is assumed. For this process electrons of energy between 4 eV and 9 eV approximately are effective. However, where small amounts of oxygen are admixed to argon, the form of the energy distribution differs markedly from a Maxwellian. This follows from a comparison of the observed and calculated attachment rates. The latter are obtained from the theoretical values of the mean electron energy which are made compatible with measured values of the electron drift velocity. The calculated attachment rate is much too high, indicating a shortage of the fast electrons necessary for dissociative attachment in the actual energy distribution prevailing. Though this distribution for a gas mixture is not derived here, it appears that the Ramsauer–Townsend effect and the energy loss in inelastic collisions determine its shape. A.

537.542

2351. CALCULATION FOR A THICK-WALLED GRAPHITE IONIZATION CHAMBER DESIGNED FOR MEASURING HIGH GAMMA ENERGY (UP TO 50 MeV). C.Schuhl.
J. Phys. Radium, Vol. 17, Suppl. No. 3, 97 A - 103 A (June, 1956). In French.

The calculation is based on Gray's formula. Electron energy losses by primary and secondary effects are considered. Mean ranges of electrons in C are calculated, and compared with those of other workers. Relative stopping powers for C–air are calculated from the formula of Rossi and Greisen. The expression deduced for the response of an ionization chamber is plotted for wall thicknesses of 4.5 cm, 9 cm and 13.5 cm for incident radiation up to 50 MeV. The design of a graphite chamber having walls 4.5 cm thick and a large cylindrical air volume (100 cm^3) is described. The response of this chamber to 22 MeV betatron radiation is compared with that of a thick-walled "Victoreen" chamber. The number of incident photons required to produce 1 roentgen in the "Victoreen" chamber under these conditions is comparable with values determined by other workers. D.V.Mabbs

537.542 : 621.374.5

2352. TIME SELECTORS USING DELAY LINES. J.Thenard and H.Guillon.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 57A-59A (June, 1956). In French.

Discusses the use of delay lines as a means of regulating the generation of equi-spaced impulses in time measuring apparatus. An apparatus is suggested capable of measuring time intervals between 0.5 μsec and 50 μsec to an accuracy of 0.5 μsec. G.D.Sims

537.542 : 621.375.018.756

2353. NONBLOCKING DOUBLE-LINE LINEAR PULSE AMPLIFIER. E.Fairstein.
Rev. sci. Instrum., Vol. 27, No. 7, 475-82 (July, 1956).

A linear amplifier with a 1.2 μsec clipping time and a gain of 50 000 suitable for scintillation spectrometry is described. Low-energy photoelectric peaks can be resolved under conditions in which the unwanted background has a rate in excess of 100 000 c/s and has components 40 times more energetic than the desired spectrum. No shift in the energy axis is observed under these conditions. A.

537.542 : 778.34

2354. CLOUD CHAMBER TRACK MEASURING INSTRUMENT. P.C.Fisher.
Rev. sci. Instrum., Vol. 27, No. 10, 873-4 (Oct., 1956).

Describes a lens-prism combination used to measure large radius, short cloud length cloud-chamber tracks, which utilizes monochromatic light and a simple inexpensive prism. Track radii of from 40 cm to 130 cm may be measured with this device, the probable errors in measurement range, in practice, from 2%-4% for tracks of 11 cm cloud length. P.Rothwell

537.542 : 778.34

2355. OPTICAL SYSTEM TO SIMPLIFY ANALYSIS OF BUBBLE CHAMBER PHOTOGRAPHS. N.P.Campbell and I.A.Pless.
Rev. sci. Instrum., Vol. 27, No. 10, 875 (Oct., 1956).

Two cameras, 90° apart, are used to take stereoscopic photographs of events in a bubble chamber. A spherical correcting lens is placed between each camera and the bubble chamber, so that only rays leaving the chamber essentially perpendicular to its median plane can reach the camera. The projection of the track on to the film in then an orthographic instead of a point or conical projection, and no correction need be made for the depth of the event in the chamber. The small errors which are introduced by the system are also discussed. P.Rothwell

537.542

2356. NEGATIVE PRESSURE ISOPENTANE BUBBLE CHAMBER. I.A.Pless and R.J.Plano.
Rev. sci. Instrum., Vol. 27, No. 11, 935-7 (Nov., 1956).

A negative pressure bubble chamber utilizing isopentane for the sensitive fluid is described. The chamber is of all glass construction which gives it a comparatively long sensitive time and allows the use of 90° stereophotography with consequent advantages in the speed and accuracy of analysis. An approximate theory for negative-pressure bubble chambers is given. The construction and operation of the chamber is described. A.

IONIZATION. THERMIONICS 537.56/.58

537.561 : 539.153.4

2357. IONIZATION POTENTIAL: ANALYTICAL INTERPRETATION. C.Bedreag.
C.R. Acad. Sci. (Paris), Vol. 243, No. 10, 773-5 (Sept. 3, 1956). In French.

Regularities are pointed out in the variation of ionization potentials of d-electrons with the atomic number, and it is shown that this behaviour follows qualitatively Sommerfeld's (1933) formula based on the Thomas–Fermi equation. L.Pincherle

537.561

2358. IONIZATION POTENTIAL OF THE OH FREE RADICAL BY MASS SPECTROMETRY. S.N.Foner and R.L.Hudson.
J. chem. Phys., Vol. 25, No. 3, 602-3 (Sept., 1956).

Average value of ionization potential I(OH) was found to be 13.18 ± 0.1 eV; $I(H_2O)$ = 12.61 ± 0.1 eV and $A(OH^+)$ from H_2O = 18.19 ± 0.1 eV. The difference between the energies $A(OH^+)$ and I(OH), 5.03 ± 0.2 eV, gives the upper limit for the dissociation energy of the H–OH band. C.G.Morgan

537.561

2359. IONIZATION POTENTIALS OF CARBONYL MOLECULES. K.Higasi, I.Omura and H.Baba.
Nature (London), Vol. 178, 652 (Sept. 22, 1956).

The first ionization potentials of X.CHO, X.CO.CH_3 and Y.$COCH_3$ (X = H, CH_3, NH_2, OH; Y = CH_2CH_3, $NH.CH_3$, OCH_3) are reported. The trend in the ionization potentials can be explained in terms of the inductive effects of the substituents. This is unexpected since the mesomeric effect counteracts the inductive effect in many of the groups, and the mesomeric effect is generally supposed to be more important. G.Allen

537.562

2360. METASTABLE OXYGEN MOLECULES PRODUCED BY ELECTRICAL DISCHARGES. S.N.Foner and R.L.Hudson.
J. chem. Phys., Vol. 25, No. 3, 601-2 (Sept., 1956).

Mass spectrometer measurements using a collision-free molecular beam sampling system suggest that metastable O_2 molecules in the $^1\Delta g$ state are produced by electrical discharges. Analysis of the results indicates that the $O_2(^1\Delta g)$ concentration is 10-20%. G.I.W.Llewelyn

537.564

2361. FORMATION OF NEGATIVE IONS BY MEANS OF TRANSFER OF CHARGE. V.M.Dukel'skiĭ.
Dokl. Akad. Nauk SSSR, Vol. 105, No. 5, 955-7 (1955). In Russian.

A new method of obtaining negative ions of elements, whose vapours are monoatomic (Ag, Cu, Au), was tried. As a result of collisions, transfer of charge takes place between the ions of donor substance, which are formed readily in presence of electrons, and acceptor atoms. Negative ions of silver, $(Ag^{107})^-$ and $(Ag^{109})^-$, and of copper, $(Cu^{63})^-$ and $(Cu^{65})^-$, were obtained with antimony as donor substance. Ions of gold, Au^-, and of chromium, $(Cr^{50})^-$, $(Cr^{52})^-$, $(Cr^{53})^-$, $(Cr^{54})^-$ were obtained using bismuth. Currents, corresponding to the lines of Ag^-, Cu^- and Au^- in the mass spectrometer, could be made as large as 1×10^{-10} A. Z.Krasucki

537.564

2362. MEASUREMENT OF MOLECULAR EXCITATION POTENTIALS BY MEANS OF AN ION SOURCE. J.Momigny.
J. chem. Phys., Vol. 25, No. 4, 787 (Oct., 1956).

The appearance of molecular ions at energies below the ground state ionization potentials suggests a non-negligible probability of the molecules being struck twice by electrons. The abnormal part of the ionization curves are studied by plotting the ratio of ionic intensity increase to electron energy against electron energy. Thus inflection and singular points of these curves together with the initial break-up point can be correlated with known energy levels. J.Jacobs

537.564

2363. IONIZATION OF INERT GASES BY POSITIVE POTASSIUM IONS. D.E.Moe.
Phys. Rev., Vol. 104, No. 3, 694-9 (Nov. 1, 1956).

Ionization of the inert gases by relatively low-energy potassium ions has been investigated. The use of relatively intense ion beams and phase-sensitive detection of ionization signals yields a large increase in sensitivity over that obtained in former investigations. The enhanced sensitivity permits detection of ionization at lower ion energies than heretofore reported. Evidence is presented for a real ionization threshold potential for K^+ ions in Kr. Both the absolute ionization cross-section and its derivative with respect to ion energy are reported. The latter shows a fine structure which is characteristic of the bombarded gas. The electron energy distribution of the ionization electrons is determined from stopping-potential curves and is found to be characteristic of the bombarded gas. In general, the energy distribution of the ionization electrons is independent of the incident ion energy. The results of this investigation support the qualitative theory of ionization by ions proposed by Weizel. A.

537.564

2364. TOWNSEND IONIZATION COEFFICIENTS AND UNIFORM FIELD BREAKDOWN IN HYDROGEN AND NITROGEN AT HIGH PRESSURES. D.J.DeBitetto and L.H.Fisher.
Phys. Rev., Vol. 104, No. 5, 1213-20 (Dec. 1, 1956).

Values of α/p, the first Townsend coefficient divided by the pressure, reproducible to a few percent were measured in hydrogen and nitrogen by the standard Townsend procedure for the range of pressure p times electrode separation d of 100 to 800 mm Hg x cm. Values of α/p were obtained for the range of field strength to pressure ratio E/p of 14 to 22 and 30 to 45 volt cm^{-1} (mm Hg)$^{-1}$ in hydrogen and nitrogen, respectively. Current–voltage measurements at constant values of p and d taken to within 0.05% of the breakdown potential check the consistency of the α/p measurements and demonstrate the existence of the second Townsend coefficient γ for pd values as high as 750 in nitrogen and 800 in hydrogen. The primary multiplication at breakdown is only about 10^3 for both gases, and the existence of γ is necessary to account for total multiplications of 10^5 measured just below breakdown. The values of γ are reproducible to within about 20% for fixed values of p, d, and E/p, provided the nickel cathode used is not unduly abused by heavy currents. The values of γ are about 10^{-3} for values of E/p of about 20 in hydrogen and 40 in nitrogen, and were found to be unfalsified by space charge. Measured values of the breakdown potential in both gases are given within experimental error by the Townsend condition $\gamma(e^{\alpha d}-1) = 1$. Variations of the state of the nickel cathode for both gases at constant p and d give rise to changes in both γ and the breakdown potential in accord with the Townsend condition. Alternately, values of the breakdown potential may be used with accurate values of α to obtain precise values of γ from the Townsend condition. A.

537.564

2365. INVESTIGATION OF THE TWO-ELECTRON CAPTURE IN COLLISIONS BETWEEN POSITIVE CARBON AND OXYGEN IONS WITH GAS MOLECULES. Ya.M.Fogel', R.V.Mitin and A.G.Koval'.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 397-404 (1956). In Russian.

A double mass-spectrometric arrangement was used to study the capture of two electrons by singly charged carbon or oxygen ions during collisions with He, Ne, A, Kr, Xe atoms or H_2, N_2 and O_2 molecules. The effective cross-sections for these processes were measured for C^+, and O^+ ions possessing energies between 10.7 and 54.5 keV. A.

537.564

2366. DETACHMENT OF ELECTRONS FROM NEGATIVE HALOGEN IONS IN COLLISIONS WITH INERT GAS ATOMS AND HYDROGEN MOLECULES. Yu.F.Bydin and V.M.Dukel'skiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 569-78 (1956). In Russian.

The cross-sections for detachment of an electron from F^-, Cl^-, Br^- and I^- ions in collisions with He, Ne, A, Kr, Xe atoms have been measured in the energy range from 200 to 2000 eV. The cross-sections have also been measured for Cl^-, Br^- and I^- ions colliding with H_2 molecules. Energy thresholds for electron detachment have been observed for Br^-–He (150 eV); Br^-–H_2 (160 eV); I^-–H_2 (320 eV). The I^-–He threshold has been redetermined (280 eV). The results are discussed in terms of energy transitions in a system of two slowly approaching atomic particles. A.

537.564

2367. CAPTURE OF ELECTRONS AND IONIZATION IN INTERACTION OF SINGLE CHARGED POSITIVE IONS WITH THE ATOMS OF A GAS. N.V.Fedorenko, V.V.Afrosimov and D.M.Kaminker.
Zh. tekh. Fiz., Vol. 26, No. 9, 1929-40 (1956). In Russian.

Studying single collisions of the He^+, Ne^+, A^+ ions with atoms of inert gases measurements were made of (a) total capture cross-section of electrons with a fast ion from the envelope of an atom, (b) total formation cross-section of free electrons separating off from atomic shells, (c) total formation cross-section of slow ions. Two methods of measurement were used for (a) and one method for (b) and (c) — the apparatus for both methods are described. The variations of these cross-sections were studied for ions covering an energy range of 3-180 keV. For the heavy gases A and Kr the cross-sections (a) and (b), over the middle part of the energy range, gave values of 1-2 x 10^{-15} cm^2. C.R.S.Manders

537.564

2368. IONIZATION OF GASES BY He^+, Ne^+ AND A^+ IONS WITH FORMATION OF MULTIPLY CHARGED IONS DURING SINGLE INTERACTION. N.V.Fedorenko and V.V.Afrosimov.
Zh. tekh. Fiz., Vol. 26, No. 9, 1941-54 (1956). In Russian.

Single collisions of the He^+, Ne^+, A^+ ions, of energies covering the range 3-180 keV, with atoms of He, Ne, A and Kr were investigated. The slow ions formed were drawn out of the gas filling the collision chamber in a direction perpendicular to that of the primary beam and then examined by a magnetic mass spectrometer. The formation of ions with up to five charges was observed. Methods described previously (see preceding abstract), were employed for studying the formation cross-sections. In all cases the cross-section magnitude falls off with increase of the charge of the particle formed. In most cases the formation cross-section of slow multiply charged ions increases steadily over the energy range examined. C.R.S.Manders

537.568

2369. INELASTIC HEAVY PARTICLE COLLISIONS INVOLVING THE CROSSING OF POTENTIAL ENERGY CURVES. IV. IONIC RECOMBINATION. D.R.Bates and T.J.M.Boyd.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 910-16 (Dec., 1956).

For Pt III see 8054 (1955). Calculations are carried out on the rate of simple ionic recombination between H^- ions and various positive ions $B^+(H^- + B^+ \rightarrow H + B)$. The coefficient describing the process is in general very high — at normal temperatures values of about 10^{-7} cm^3 sec^{-1} or more are to be expected. Dissociative ionic recombination $(A^- + CD^+ \rightarrow A + C + D)$ is also discussed. It may be extremely rapid. A.

537.583

2370. AUTO-ELECTRON [THERMIONIC] EMISSION OF TANTALUM. M.I.Elinson and G.F.Vasil'ev.
Zh. tekh. Fiz., Vol. 26, No. 8, 1669-71 (1956). In Russian.

A brief account of experimental investigation of tantalum (in the shape of a pointed wire) up to 2000°K and its comparison with tungsten is presented, illustrated by several microphotographs. The main conclusions are that at 1600°K the surface is freed from all adsrobed gas atoms and that oxygen adsorbed at the cold tantalum electrode tip considerably reduces the emission, but surface oxidation achieved by heating the tip in oxygen atmosphere does not materially affect the emission properties. A.Landman

COSMIC RAYS 537.591

537.591.1 : 551.510.41

2371. COSMIC-RAY PRODUCTION RATE AND MEAN REMOVAL TIME OF BERYLLIUM-7 FROM THE ATMOSPHERE. P.A.Benioff.
Phys. Rev., Vol. 104, No. 4, 1122-30 (Nov. 15, 1956).

The Be^7 production rate is given by the product of the nucleon flux ($E_{nucleon} \geq 40$ MeV), the Be^7 production cross-section, and an appropriate constant. The nucleon flux (as a function of altitude and latitude) is determined for $E_{nucleon} \geq 500$ MeV from the fairly complete theoretical treatment available in the literature. For nucleons with energy between 40 MeV and 500 MeV, an approximate theory given in the literature is used. The sum of these two gives the nucleon flux applicable to Be^7 production. The Be^7 production cross-section is obtained by multiplying the $C(p,X)Be^7$ excitation function available in the literature by the $N(p,X)Be^7/C(p,X)Be^7$ ratio obtained at BeV energies. The Be^7 production rate in the atmosphere as a function of latitude and altitude is then obtained. Since the main errors lie in the determination of the nucleon flux, the derived flux curves are compared to literature data on the latitude effect and star production rate. The agreement is found to be satisfactory and error limits are placed at ± 50%. The mixing and washout processes in the atmosphere are then considered. The production rate of Be^7 in the stratosphere is found to be 5.0 atoms/cm^2 min, and 1.3 atoms/cm^2 min for the troposphere (assumed tropopause = 35 000 ft). The production rates are used with the rain water removal rate to determine the stratosphere mean removal time as a function of the troposphere mean removal time. Curves of this function are presented for three different average tropopause elevations (30 500 ft, 35 000 ft, 40 000 ft). Compared to these curves, the approximate literature values of 120 days and 14 days for Be^7 mean removal times from the stratosphere and troposphere respectively, seem too short. Longer times are indicated, of the order of years for the stratosphere, and three weeks or more for the troposphere. Recent experimental evidence in the literature appears to confirm this. A.

537.591.1

2372. THE NUCLEONIC COMPONENT IN COSMIC RAY EXTENSIVE AIR SHOWERS. P.L.Marsden and G.A.Doran.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 894-901 (Dec., 1956).

The ratio (β) of the density of fast nucleons to that of electrons in extensive showers has been measured within 20 m of the shower axis, the nucleons being detected through the evaporation neutrons arising from the interactions of these particles. It is shown that the ratio β decreases with increasing distance from the shower axis and also decreases with increasing shower size over a range defined by electron densities in the immediate neighbourhood of the axis of from 50 to 350 m^{-2}. A.

537.591.1

2373. COMPOSITION OF PRIMARY COSMIC RAYS. V.L.Ginzburg and M.I.Fradkin.
Zh. éksper. teor. Fiz., Vol. 31, No.3(9), 523-5 (1956). In Russian.

A theory given earlier (Fortschritte der Physik, Vol. 1, 659, 1954) in which cosmic rays are assumed to be generated in surfaces of supernovae and novae, is used and a transport equation is considered in order to obtain the ratios of various elements in cosmic rays. G.E.Brown

537.591.15

2374. AN ELECTRON–PHOTON SHOWER OF VERY HIGH ENERGY REGISTERED IN NUCLEAR EMULSIONS. A.Jurak, M.Miesowicz, O.Stanisz and W.Wolter.
Bull. Acad. Polon. Sci. Cl 3, Vol. 3, No. 7, 369-72 (1955).

An event has been observed in a large stack of emulsions which can be interpreted as an electron–photon cascade initiated by a single photon of high energy (~ 10^{11} eV). The number of high-energy electrons observed exceeds the number predicted by theory. Possible explanations of this discrepancy are suggested. A.J.Egginton

537.591.15

2375. DIRECTIONAL MEASUREMENTS ON EXTENSIVE AIR SHOWERS. P.Rothwell, B.Wade and A.Goodings.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 902-9 (Dec., 1956).

A search has been made for localized sources of high energy cosmic rays, by measuring the directions of arrival of the particles in extensive air showers with cloud chambers run in coincidence with a counter detecting system. An angular resolution rather better than 5° was achieved. No sources have been found between latitudes 10°N and 90°N on the celestial sphere for showers of average energy 8×10^{15} eV. A.

537.591.2

2376. THE ENERGY DISTRIBUTION OF COSMIC RAY PARTICLES OVER NORTHERN ITALY. P.H.Fowler and C.J.Waddington.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 637-50 (July, 1956).

The energies of 200 multiply-charged particles of the primary cosmic radiation have been determined from measurements of the multiple Coulomb scattering. These particles were found in a stack of emulsions exposed over Northern Italy. The energy determinations have been shown to be reliable up to an energy of at least 3.0 BeV per nucleon. From these measurements the cut-off energy has been shown to be 1.55 ± 0.06 BeV per nucleon, instead of the 1.05 BeV per nucleon predicted by geomagnetic theory. The integral energy spectrum between 1.8 and 3.0 BeV per nucleon has been shown to be given by $N(>E) = 370/(m_0c^2 + E)^{1.50}$, and between the above cut-off energy and 800 BeV per nucleon — from a consideration of α-particle produced "jets" — to have an exponent of 1.49. A value for the α-particle flux at the top of the atmosphere has been found of 93 ± 8 α-particle/m^2 $ster^{-1}$ sec^{-1}. A.

537.591.5

2377. A NOTE ON THE ZENITH ANGLE DEPENDENCE OF COSMIC RAY PROTONS AT SEA LEVEL. K.W.Ogilvie.
Canad. J. Phys., Vol. 34, No. 10, 1081-6 (Oct., 1956).

The "heavy particle selector" described in previous papers (Abstr. 8884/1955, 1338/1956) has been used to study the angular dependence of protons in the momentum range 700-1100 MeV/c. Comparison with the theory shows agreement for an angular spread of the protons represented by a $\cos^6\theta$ law. A.J.Egginton

537.591.5

2378. ON THE THEORY OF METEOROLOGICAL EFFECTS ON COSMIC RADIATION. L.I.Dorman.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 433-6 (1954). In Russian.

An analytical expression relating the μ-meson intensity at a given height to various meteorological factors is deduced. W.O.Lock

537.591.5 : 539.172

2379. THE LATITUDE EFFECT OF NUCLEAR DISINTEGRATIONS IN THE STRATOSPHERE. V.S.Murzin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 443-6 (1954). In Russian.

A spherical aluminium argon-filled ionization chamber surrounded by 23 counters was flown at 23-27 km height and the integral pulse height spectrum determined at 0°, 31°N, 38°N and 51°N. The data are used to give information about high-energy nuclear disintegrations of light elements. W.O.Lock

537.591.5

2380. THE CONTRIBUTION OF METEOROLOGICAL CHANGES IN THE EARTH'S ATMOSPHERE TO THE DIURNAL EFFECT IN COSMIC RAYS. A.I.Kuz'min.
Zh. éksper. teor. Fiz., Vol. 28, No. 5, 614-16 (1955). In Russian. English translation in: Soviet Physics JETP (New York), Vol. 1, No. 3, 560-2 (Nov., 1955).

The cosmic-ray hard component was investigated at 100 m with an accuracy of ≅ 0.3% per hour. The contribution to the diurnal effect by meteorological factors has been investigated previously but without considering the vertical redistribution of the atmosphere. This was taken into account in the present work using a theoretical scheme of Feinberg (Dokl. Akad. Nauk SSSR, Vol. 53, 421/1946) and Dorman (see preceding abstract). Averaged data from 72 day–night pairs of ≥ 12 km radio-sonde flights were used to compute theoretical curves for the daily meteorological variation δN of the hard-component intensity. These curves were in opposite phase to the experimental curves of diurnal hard-component variations δI_h corrected for barometric effect (−0.14% per mb), contrary to previous findings. The meteorological effect correction thus increases the amplitude of the cosmic-ray hard-component diurnal variation, bringing it up to ≅ 1%. The correctness of the model used is confirmed by the sign of the summer–winter effect obtained by taking seasonal averages of δI_h. See also Abstr. 5201-2/1956.

R.H.W.Johnston

537.591.5 : 523.75

2381. INCREASE OF COSMIC RAY INTENSITY IN JAMAICA DUE TO A SOLAR FLARE. J.C.Barton and J.H.Stockhausen.
J. atmos. terrest. Phys., Vol. 9, No. 2-3, 161-2 (Aug.-Sept., 1956).

A sharp increase in cosmic-ray intensity was recorded during the night 22-23 February 1956 at latitude 18° 0' N and longitude 76° 44' W.

A.J.Egginton

537.591.5

2382. ANISOTROPY OF COSMIC RAYS DUE TO THE GALACTIC ROTATION. A.O.Barut.
Nuovo Cimento (Ser. 10), Vol. 4, No. 3, 661-5 (Sept., 1956).

Calculations of the Compton–Getting effect have been extended, and it is shown that for high-energy particles the intensity change shows a maximum at 20 h 40 min; the amplitude of the change varies between +0.16 ± 0.05 and −0.16 + 0.05 at latitude 0°, and between 0.16 ± 0.05 and 0 at latitude of about 45°. The change at latitude 90° is zero. Approximate results for low energy particles are also given.

E.W.Kellermann

537.591.5

2383. ANISOTROPY OF COSMIC RAYS DURING THE COSMIC-RAY STORMS. S.Yoshida.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1410-32 (Dec., 1956).

Various phenomena about the cosmic-ray diurnal variations, especially anomalous diurnal variations associated with geomagnetic storms, were studied. A very important part of cosmic-ray diurnal variations was interpreted as the result of the anisotropic flow of cosmic-rays which takes place during the cosmic-ray storms. Through a study of the energy and latitude dependence of the anomalous diurnal variations, it was indicated that this anisotropy is produced by the acceleration of cosmic rays in the solar stream. The variations of this acceleration observed at various positions in a solar stream, the variations in different streams of various ages and the variation in an eleven-year period are described.

A.

537.591.5

2384. ATMOSPHERIC EFFECTS ON THE COSMIC RAY TOTAL INTENSITY AT SEA LEVEL. F.Bachelet and A.M.Conforto.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1479-95 (Dec., 1956).

The atmospheric effects on the total intensity of cosmic rays at sea-level have been studied by three different methods proposed by Duperier, Olbert and Dorman. One year's cosmic-ray measurements have been analysed with respect to the day-to-day and seasonal variation. The results are compared with those of other authors.

A.

537.591.5

2385. THE SOLAR DAILY VARIATION OF THE COSMIC RAY INTENSITY. H.Elliot and P.Rothwell.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 669-76 (July, 1956).

Some recent measurements of the solar daily variation for cosmic rays incident from the east and west directions at 45° to the vertical in London are described. The results do not agree with those to be expected if the variation was due to a non-isotropic flux of primary particles entering the earth's magnetic field. This result is discussed in relation to other evidence and it is concluded that the daily variation is probably due to a modulation of the primary cosmic ray intensity in the earth's magnetic field.

A.

537.591.5

2386. DIRECTIONAL INTENSITIES OF POSITIVE AND NEGATIVE MESONS IN THE ATMOSPHERE. F.B.Harris and I.Escobar,V.
Phys. Rev., Vol. 104, No. 2, 542-4 (Oct. 15, 1956).

Intensities of μ-mesons at zenith angles of $22\frac{1}{2}^\circ$ and $67\frac{1}{2}^\circ$ at Chacaltaya, Bolivia are found to be in good agreement with the theory given by Harris and Escobar. Data taken at zenith angles of 45° at Echo Lake, Colorado confirm that part of the theory which describes the effect of the terrestrial magnetic field on the μ-mesons after their production in the atmosphere.

A.

537.591.5 : 523.165

2387. SOLAR COSMIC RAYS OF FEBRUARY, 1956 AND THEIR PROPAGATION THROUGH INTERPLANETARY SPACE. P.Meyer, E.N.Parker and J.A.Simpson.
Phys. Rev., Vol. 104, No. 3, 768-83 (Nov. 1, 1956).

The data from six neutron-intensity monitors distributed over a wide range of geomagnetic latitudes have been used to study the large and temporary increase of cosmic-ray intensity which occurred on February 23, 1956, in association with a solar flare. During the period of enhanced intensity a balloon-borne neutron detector measured the absorption mean free path and intensity of the flare particles at high altitudes. From these experiments the primary particle intensity spectrum as a function of particle rigidity, over the range < 2 to $>$ 15-30 BV rigidity, has been deduced for different times during the period of enhanced intensity. It is shown that the region between the sun and the earth should be free of magnetic fields greater than $\sim 10^{-6}$ gauss and that the incoming radiation was practically isotropic for more than 16 hours following maximum flare particle intensity. The decline of particle intensity as a function of time t depends upon the power law $t^{-3/2}$, except for high-energy particles and late times, where the time dependence approaches an exponential. The experiments lead to a model for the inner solar system which requires a field-free cavity of radius greater than the sun-earth distance enclosed by a continuous barrier region of irregular magnetic fields [B (r.m.s.) ≅ 10^{-5} gauss] through which the cosmic-ray particles must diffuse to reach interstellar space. This barrier is also invoked to scatter flare particles back into the field-free cavity and to determine the rate of declining intensity observed at the earth. The diffusion mechanism is strongly supported by the fact that the time dependence $t^{-3/2}$ represents a special solution of the diffusion equation under initial and boundary conditions required by experimental evidence. The coefficient of diffusion, the magnitude of the magnetic field regions, the dimensions of the barrier and cavity, and the total kinetic energy of the high-energy solar injected particles have been estimated for this model. Recent studies of interplanetary space indicate that the conditions suggested by the experiments may be established from time to time in the solar sytem. The extension of the model to the explanation of earlier cosmic-ray flare observations appears to be satisfactory. The solar flare event was superposed by chance upon a large but typical intensity decrease of nonsolar cosmic-rays which began several days prior to February 23. Hence, the flare particles have been used as probes to explore the intensity modulation mechanism responsible for this decrease of background cosmic-ray intensity.

A.

537.591.5

2388. EFFECTS OF A RING CURRENT ON COSMIC RADIATION. IMPACT ZONES. E.C.Ray.
Phys. Rev., Vol. 104, No. 5, 1459-62 (Dec. 1, 1956).

An investigation of the effects of a ring current on the "0900" (geomagnetic local time) impact zone of flare-associated cosmic-ray intensity increases has been carried out using 55 trajectories calculated on an automatic computer. The particles considered have rigidities of 2 BV, 6 BV, and 10 BV, and arrive at the earth from the vertical direction. Reasonable ring currents shift the longitude of impact by as much as half an hour from that predicted by the dipole theory. The shift may be in either direction, depending on the exact ring parameters chosen. Experimental data so far published are not sufficiently accurate to test the theory. Because of the finite width of observed impact zones together with the rather small shift predicted here, the experimental test is inherently difficult.

A.

537.591.5

2389. THE DIURNAL VARIATION OF THE COSMIC RADIATION. II. E.Remy and A.Sittkus.
Z. Naturforsch., Vol. 11a, No. 7, 556-61 (July, 1956). In German.

For Pt I see Abstr. 6271 (1955). Since 1953 the total cosmic ray

intensity has been measured at Freiburg (48°N, 8°E; 1200 m) by means of a counter telescope containing counter areas large enough to obtain the diurnal variation from an average over three days only. The telescope is sensitive to varying ranges of angles of incidence. It is found that there are often several maxima and minima during one day. The diurnal variation of the radiation arriving vertically differs from that of the radiation coming from inclined directions. It is believed that there is a correlation with 27-day period terrestrial magnetic disturbances. E.W.Kellermann

537.591.8 : 539.172

2390. MECHANISM OF COLLISION OF HIGH-ENERGY NUCLEONS WITH LIGHT NUCLEI. N.L.Grigorov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 835-8 (1954). In Russian.

The cascade equations are solved under the assumptions that high-energy ($E > 1.5 \times 10^9$ eV) nucleons lose, on the average, 30% of their energy in collisions with light nuclei and that the remaining energy is carried off by one nucleon. G.E.Brown

537.591.8

2391. GENERATION OF PENETRATING PAIRS BY THE NEUTRAL COMPONENT OF COSMIC RADIATION. A.V.Khrimyan.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 853-6 (1954). In Russian.

An arrangement of counters, absorbers and a magnetic field constituted a mass spectroscope which was operated at 3250 m above sea-level. Five pairs of oppositely charged penetrating particles were observed, which interacted weakly with matter. In each case the pair was produced by neutral radiation, in contrast with the underground observations of other workers. W.O.Lock

537.591.8

2392. ON THE TRIDENT CROSS-SECTION BETWEEN 1 AND 10 GeV. F.A.Brisbout, C.Dahanayake, A.Engler and D.H.Perkins.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1496-503 (Dec., 1956).

An estimate has been made of the trident cross-section for electrons of energy between 1 and 10 GeV. Energy determinations were made by scattering measurements on each track under conditions where the effects of spurious scattering have been shown to be negligible. In a total track length of 219 cm, the estimated number of true tridents was found to be 3, as compared with 2.4 expected from theory. Even on the basis of this small number of events, there is a marked discrepancy between our results and those of previous experiments at high energies. Reasons for this discrepancy are discussed. A.

537.591.8

2393. A LIQUID SCINTILLATOR INVESTIGATION OF THE SECOND MAXIMUM IN THE COSMIC RAY TRANSITION CURVE. P.D.McCormack.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 845-52 (Nov., 1956).

A liquid scintillator, designed to detect stars produced in the phosphor by the cosmic radiation at sea level, has been used to investigate the star transition curve at depths of lead absorber in the region of twenty centimetres. The anomalous maximum at depth of twenty centimetres, first reported by Schopper, Hörcker and Rössle, has been confirmed. It appears that low energy μ-mesons are the most likely primaries, the stars being produced by neutrons released in the slow μ-meson nuclear absorption process. A.

MAGNETISM 538

538.113

2394. DIAMAGNETISM OF GRAPHITE. J.W.McClure.
Phys. Rev., Vol. 104, No. 3, 666-71 (Nov. 1, 1956).

The conduction-electron magnetic susceptibility of graphite has been calculated by using the Wallace two-dimensional band structure. The energy levels induced by the magnetic field are calculated by the method of Luttinger and Kohn, taking into account the large (in this case) effects of band-to-band transitions which are not included in the Landau–Peierls treatment. Agreement with the susceptibility observed at high-temperatures is obtained with a choice of 2.6 eV for the resonance-integral parameter γ_0. The details of the de Haas–van Alphen effect cannot be reproduced, indicating that a more complicated band structure is needed to account for the low-temperature experiments. A.

538.113 : 539.11

2395. THEORY OF CYCLOTRON RESONANCE IN METALS. M.Ya.Azbel' and É.A.Kaner.
Zh. éksper. teor. Fiz., Vol. 30, No. 4, 811-14 (1956).

This paper predicts and studies theoretically a new form of resonance in metals, fundamentally different from diamagnetic resonance, which is unfortunately often termed "cyclotron resonance" in the literature. In metals near resonance the skin depth is much less than the radius of the electron orbit in the magnetic field. Thus, in a constant magnetic field parallel to the surface of the metal, an electron moving in a helical orbit through a number of revolutions will return several times to the skin layer where the electric field is large, and its motion is similar to that of an electron in a cyclotron with a single gap. Resonance will occur at a cyclotron frequency $\Omega_0 = eH/mc$ ($\omega = q\Omega_0$, $q = 1,2, \ldots$) (diamagnetic resonance in semiconductors occurs at $\omega = \Omega_0$) where ω = the angular frequency of the electromagnetic field. The condition for this resonance corresponds to that for the anomalous skin effect and so is determined by Maxwell's equations and the kinetic equation for the perturbation of the Fermi distribution. Boundary conditions are: that the perturbation function shall be periodic; and that reflection at the surface shall be diffuse. The problem is solved for the most general conditions of an arbitrary energy dependence $\epsilon(\vec{p}) = \epsilon_0$ and an arbitrary collision time. No calculations are given, but the final equation for the surface impedance close to resonance is given, together with the expression for the associated tensor and the equation for Ω. The derivation of these expressions will be published separately. The conclusions are that an experimental study would in principle show: (1) From the existence or not of resonance, if the surface $\epsilon(\vec{p}) = \epsilon_0$ is closed. (2) How far the Fermi surface differs from ellipsoidal shape. (3) What is the speed of the electrons at the Fermi surface or surfaces. W.Bardsley

538.113 : 539.11

2396. CYCLOTRON RESONANCE IN TIN AND COPPER. E.Fawcett.
Phys. Rev., Vol. 103, No. 5, 1582-3 (Sept. 1, 1956).

Reports measurements on Sn and Cu at 4.2°K using 24 kMc/s radiation and magnetic fields up to 18 kilo-oersted parallel to the metal surfaces. The results are in agreement with the theoretical predictions of Azbel' and Kaner (preceding abstract). C.A.Hogarth

538.114

2397. SPATIAL CORRELATIONS IN A FERROMAGNETIC NEAR THE CURIE POINT. P.G.de Gennes and A.Herpin.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1611-13 (Nov. 19, 1956). In French.

The mean value of the product $\delta S_0 . \delta S_R$, where δS_R is the fluctuation of the spin at R, is calculated on the basis of molecular field theory and found to be proportional to $\exp(-k_1 R)/Rr_1^2$, where $r_1 = 1.17$ A for iron and k_1^2 is proportional to $|1 - T/\theta|$ near the Curie point θ. E.P.Wohlfarth

538.114

2398. FERROMAGNETIC CURIE TEMPERATURES BY THE KRAMERS–OPECHOWSKI METHOD. H.A.Brown.
Phys. Rev., Vol. 104, No. 3, 624-5 (Nov. 1, 1956).

The method of Kramers and Opechowski for obtaining the partition function of a magnetic lattice with nearest neighbour interaction as a power series in inverse temperature is extended to the fifth degree for the body-centred and simple cubic and the quadratic layer lattices. Curie temperatures inferred from the behaviour of the susceptibility demonstrate the internal consistency of the approach and show satisfactory agreement with the results of the Bethe–Peierls–Weiss method. A.

538.114 : 539.23

2399. RESONANCE AND REVERSAL PHENOMENA IN FERROMAGNETIC FILMS. R.L.Conger and F.C.Essig.
Phys. Rev., Vol. 104, No. 4, 915-23 (Nov. 15, 1956).

For fields several times the coercive force, magnetization reversal in thin films takes place by domain rotation. A phenomenological theory based on a modification of the Landau–Lifshitz equation of motion shows that the reversal time for this type of magnetization reversal will be proportional to the damping constant of the modified equation of motion. This damping constant is in turn proportional to the ferromagnetic resonance absorption line width. Experimental measurements on evaporated films of three different alloy compositions demonstrate this predicted proportionality of the reversal time and the resonance line width. The shift in the value of the resonant field strength at constant frequency as a function of film thickness was also investigated. This shift can be attributed to a decrease in the saturation magnetization, $4\pi M_0$. The results indicate that the saturation magnetization remains reasonably constant down to a film thickness of about 10^{-5} cm, and then decreases rapidly. The resonance line widths of the thickest and the thinnest films tested of a given composition were about the same. A.

538.114

2400. FERROMAGNETIC RESONANCE IN METAL SINGLE CRYSTALS. J.O.Artman.
Phys. Rev., Vol. 105, No. 1, 74-84 (Jan. 1, 1957).

Microwave susceptibility expressions for ferromagnetic resonance have been derived for metal single crystals possessing crystalline anisotropy. Crystals of uniaxial and cubic magnetic symmetry are considered. When the magnetization $\vec{M}$ is aligned with the applied field $\vec{H}$, the results are equivalent to those of Kittel. When a simple multidomain structure occurs on a crystal face, two resonances are found for a given H. These correspond to microwave excitation being perpendicular or parallel to $\vec{H}$. These multidomain resonances are related to H, saturation magnetization M, anisotropy parameter K/M, and the ratio of skin-depth to domain width. Thus domain spacings can be inferred from microwave measurements. In particular, predictions of the theory are compared with the microwave measurements of Kip and Arnold and magnetic domain pattern observations in the literature. Secondary resonances found in Ni by Reich can also be attributed to a multidomain structure. A.

538.114

2401. ANGLES BETWEEN MAGNETIC SPIN DIRECTIONS IN IRON-DEFICIENT MAGNESIUM MANGANESE FERRITES. W.P.Osmond.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1319-25 (Dec., 1956).

Magnesium manganese ferrites containing less than 50% (mol) Fe_2O_3 must contain tri- or tetravalent manganese if there is to be no oxygen deficiency. For some compositions this entails electronic conduction and ferromagnetic coupling between manganese ions of different valencies in the same type of lattice site. Reported magnetic data on a number of such ferrites show significant departures from the results to be expected with probable ionic distributions in the spinel lattice if all A sub-lattice spins were anti-parallel to all B sub-lattice spins. Existing theoretical work on the occurrence of angles between the spin directions of two different kinds of magnetic ions is applied to two groups of ions in one or both sub-lattices. The Mn^{3+} and exchanging Mn^{2+} ions are treated as one group, the other group consisting of the Fe^{3+} ions and any excess Mn^{2+} ions. In view of the necessary averaging assumptions the degree of agreement found between observed trends and those predicted by the theoretical treatment is satisfactory. The angles concept is here considered as a mathematical expression of average relative spin directions rather than as indicating a physical ordering of spins. Thus other groupings might possibly show the same trends, the basic causes being unaltered. A.

538.114

2402. ON THE IMPORTANCE OF THE DENSITY OF DISLOCATIONS FOR THE THEORY OF THE COERCIVE FORCE OF RECRYSTALLIZED MATERIALS. M.Kersten.
Z. angew. Phys., Vol. 8, No. 10, 496-502 (Oct., 1956). In German.

A theory of coercive force is developed in which it is supposed that the boundary walls between domains are fixed at dislocations and, in between the dislocations, distort into cylindrical form under the influence of an applied magnetic field. An expression for the coercive force is obtained which gives values of the correct order and which gives a relation between the coercive force and the temperature, for iron, which is in excellent agreement with the observed results. Using the expression for the coercive force and the known values for different materials, the surface density of dislocations in the materials can be calculated. The values obtained are of the order of 10^6 cm^{-2} which is in good agreement with values obtained in other ways. The theory is also applied to the relation between coercive force and initial permeability, and to the volumes of material involved in Barkhausen discontinuities. A.E. De Barr

538.122

2403. ON A MINIMAL PRINCIPLE IN THE THEORY OF MAGNETISM. D.Graffi.
Ann. Univ. Ferrara Sez. VII, Vol. 3, 25-9 (1954). In Italian.

A treatment of the magnetic field due to steady currents in the presence of magnetizable bodies, in general ferromagnetic and anisotropic, but without hysteresis. The principle established is: in the class of all fields compatible with the currents, the actual field due to the currents in the presence of the magnetizable bodies minimizes the total complementary energy.

Mathematical Reviews

538.22

2404. ON THE MAGNETIC PROPERTIES OF METALLIC EUROPIUM (PRELIMINARY STUDY). C.Henry la Blanchetais and F.Trombe.
C.R. Acad. Sci. (Paris), Vol. 243, No. 8, 707-9 (Aug. 20, 1956). In French.

Measurements of the magnetic susceptibility of metallic Eu^{++} show that the ferromagnetic Curie point is approximately 90°K. The difference between this value and that for Gd^{+++} (289°K), which has the same electronic configuration, is attributed to the different interaction forces as a result of the different crystal structures of the two elements. A.E.De Barr

538.22

2405. PRINCIPAL MAGNETIC SUSCEPTIBILITIES OF FERROUS CHLORIDE. H.Bizette, C.Terrier and B.Tsaï.
C.R. Acad. Sci. (Paris), Vol. 242, No. 13, 895-8 (Sept. 24, 1956). In French.

Reports results of measurements of $\chi_\perp$ and $\chi_\parallel$ in fields up to 2.5×10^4 oersted and at temperatures between 4° and 200°K; $\chi_\perp$ is independent of field strength and also of temperature below the Néel temperature (75°K), but $\chi_\parallel$ varies with field strength below this temperature. Its maximum, lying at the Néel point in low fields, moves to lower temperatures as the field strength increases and tends to disappear above about 1.9×10^4 oersted. The results are discussed in relation to the atomic structure. E.P.Wohlfarth

538.22

2406. EXPERIMENTAL INVESTIGATION OF MOLECULAR FIELD TYPE INTERACTIONS. SOLID SOLUTIONS OF A FERROMAGNETIC OR ANTIFERROMAGNETIC METAL IN PALLADIUM. J.Cohen.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1613-16 (Nov. 19, 1956). In French.

Reports results of susceptibility measurements between room temperature and 800°C on Pd—Ni alloys (Ni content up to 17%) and Pd—Cr alloys (Cr content up to 17.5%) and deduces the values of the paramagnetic Curie temperatures and the Curie constants.

E.P.Wohlfarth

538.22

2407. MAGNETIC SUSCEPTIBILITY OF RUBIDIUM AND THE ELECTRICAL RESISTANCE ANOMALY. F.T.Hedgcock.
Canad. J. Phys., Vol. 34, No. 11, 1164-7 (Nov., 1956).

Previous investigations of the resistivity—temperature curve of rubidium showed there to be an anomaly at 180°K. It has since been shown that there is no crystallographic change here and the present work suggests that the anomaly is not due to an electronic transition of the type originally suggested. The conclusion is drawn that the anomaly may be attributable to small amounts of oxygen.

F.E.Hoare

538.22 : 541.67

2408. MAGNETIC SUSCEPTIBILITIES OF URANIUM (V) AND URANIUM (III) CHLORIDES. P.Handler and C.A.Hutchison,Jr.
J. chem. Phys., Vol. 25, No. 6, 1210-13 (Dec., 1956).

The magnetic susceptibilities of UCl_5, UCl_3, and solutions of UCl_3 in $LaCl_3$ have been measured in the temperature range from 14°K to 300°K. The results are presented graphically and their general form is discussed. The susceptibility of UCl_3 apparently undergoes an antiferromagnetic transition just above the boiling point of H_2. As UCl_3 is diluted with $LaCl_3$ the behaviour of the magnetic susceptibility approaches closely that of $Nd(C_2H_5SO_4)_3.9H_2O$. The magnetic behaviour of UCl_3 is consistent with that expected for an ion with three unpaired f electrons. A.

538.22

2409. MAGNETIC PROPERTIES, ANTIFERROMAGNETISM AND FERROMAGNETISM OF $MnAu_2$. A.J.P.Meyer and P.Taglang.
J. Phys. Radium, Vol. 17, No. 6, 457-65 (June, 1956). In French.

Below 90°C and in fields less than about 10^4 oersted $MnAu_2$ has antiferromagnetic properties. By increasing the field beyond a critical value it becomes ferromagnetic, exhibiting spontaneous magnetization and a magnetocaloric effect. The critical field is a function of temperature. Above 90°C the substance is paramagnetic, the susceptibility obeying the Curie—Weiss law down to 300°C but showing pronounced deviations from this law at lower temperatures. The effect of the field is believed to be to uncouple the moments of the ions on two sublattices which are initially antiparallel and to orient them parallel to the field direction. E.P.Wohlfarth

538.22 : 548.74

2410. NEUTRON DIFFRACTION STUDY OF THE STRUCTURES AND MAGNETIC PROPERTIES OF MANGANESE BISMUTHIDE. B.W.Roberts.
Phys. Rev., Vol. 104, No. 3, 607-16 (Nov. 1, 1956).

The intermetallic compound, BiMn, has been studied by neutron diffraction at temperatures from 4.2°K to 733°K (460°C). In the temperature range 340-360°C to 445°C a disordered arrangement of Mn atoms on regular and interstitial lattice sites fits the data well if the Mn atoms are assumed to be in the paramagnetic state. This

model conflicts with the suggestion made by Guillaud of an antiferromagnetic state in this temperature range. The temperature hysteresis is associated with both magnetization and the large cell distortions are qualitatively explained by the disordering and recovery at the transformation temperatures. The effective moment per Mn atom below the transformation agrees with the magnetic measurements of Heikes within experimental error. Measurements of spin direction made at temperatures below 84°K show that only partial rotation occurs in zero magnetic field. A.

538.22 : 548.7

2411. STRUCTURAL TRANSITION AND ANTIFERROMAGNETISM IN THE ALLOY AuMn. D.P.Morris and R.P.Preston.
Proc. Phys. Soc. B, Vol. 69, Pt 8, 849-51 (Aug., 1956).

X-ray investigations showed AuMn to have a CsCl-type structure above about 125°C and to transform to an ordered body-centred tetragonal structure (c/a = 0.968) below this temperature. The susceptibility has a maximum at about 110°C and a further minimum at 70°C. Comparison is made with other measurements (Abstr. 7187/1955).

E.P.Wohlfarth

538.22

2412. EFFECT OF HYDROSTATIC PRESSURE ON MAGNETIC PROPERTIES OF MONOCRYSTALLINE Bi AT LOW TEMPERATURES. B.I.Verkin, I.M.Dmitrenko and B.G.Lazarev.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 538-40 (1956). In Russian.

A pressure of about 1500 atmospheres was applied by the ice-bomb technique to a Bi crystal in a beryllium-bronze container; the de Haas–van Alphen effect was observed by the torque method. The pressure reduced the amplitude of the oscillations several times but altered the period [Δ (1/H)] by only a few per cent (increase for field nearly parallel to, and decrease for field nearly perpendicular to, trigonal axis). The pressure also caused an appreciable increase in the anisotropy of the steady susceptibility. D.Shoenberg

538.221

2413. THE BITTER PATTERNS ON IRON–SILICON CRYSTALS WITH INTERNAL STRESSES. W.Stephan.
Exper. Tech. der Phys., Vol. 4, No. 4, 153-6 (1956). In German.

A continuation of Abstr. 6294 (1955). The maze patterns observed on the (100) surface of a Si–Fe crystal are discussed. With increasing internal stress the unfavourably oriented closure domains are reduced in volume, and the pattern is distorted. The application of external stresses tends to remove the maze pattern altogether.

E.P.Wohlfarth

538.221

2414. NEUTRON-DIFFRACTION STUDY OF FERRIMAGNETIC GARNET $Yt_3Fe_5O_{12}$. F.Bertaut, F.Forrat, A.Herpin and P.Mériel.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 898-901 (Sept. 24, 1956). In French.

From neutron-diffraction measurements with and without a magnetic field of 5600 oersted, the contribution to the scattering due to magnetization was determined, and was shown to agree well with theory. See Abstr. 4111 (1956). A.R.Stokes

538.221

2415. THE REDUCTION OF EDDY-CURRENT LOSSES IN MANGANESE–ZINC FERRITES BY THE ADDITION OF CALCIUM. C.Guillaud, M.Paulus and R.Vautier.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2712-15 (June 4, 1956). In French.

Additions of up to 1% Ca to a mixed ferrite containing 28% MnO, 19% ZnO increases the resistivity and hence reduces the eddy-current loss. The Ca atoms are found to diffuse into the grain boundaries of the ferrite. E.P.Wohlfarth

538.221

2416. MAXIMUM ENERGY PRODUCT OF CRYSTAL-ORIENTED POLYCRYSTALLINE TICONAL G (ALNICO 5) MAGNET STEEL. H.Zijlstra.
J. appl. Phys., Vol. 27, No. 10, 1249-50 (Oct., 1956).

Obtains the following values of $(BH)_{max}$ along the principal axes of a single crystal: [100], 7.6; [110], 4.6; [111], 4.2 x 10^6. The results were expressed in the form of a power series of the direction cosines and averaged over the texture of a polycrystalline magnet material with columnar crystals. E.P.Wohlfarth

538.221

2417. REVERSIBILITY OF THE COERCIVE FORCE IN ALNICO 5. M.G.van der Steeg and K.J.de Vos.
J. appl. Phys., Vol. 27, No. 10, 1250 (Oct., 1956).

The coercive force has its normal values after ageing at 600°C, but very low values after either quenching from above 750°C or annealing at this temperature, the changes being reversible. Prolonged ageing at 600°C also produces, apart from an Fe–Co rich precipitate, a face-centred-cubic phase with lattice constant 3.62 A, which disappears on heating at 820°C. This phase is believed to have a marked effect on the permanent magnet properties.

E.P.Wohlfarth

538.221 : 538.614

2418. MAGNETIC DOMAINS IN THIN FILMS BY THE FARADAY EFFECT. C.A.Fowler, Jr and E.M.Fryer.
Phys. Rev., Vol. 104, No. 2, 552 (Oct. 15, 1956).

Reports results of measurements on a transparent Ni–Fe film of thickness 500 A, using a transmission method and the Faraday effect, and obtains improved contrast as compared with results obtained by the Kerr magneto-optic reflection technique. E.P.Wohlfarth

538.221

2419. ANTIFERROMAGNETIC RESONANCE IN MnF_2. F.M.Johnson and A.H.Nethercot, Jr.
Phys. Rev., Vol. 104, No. 3, 847-8 (Nov. 1, 1956).

Reports results of measurements between 36° and 65°K and at frequencies between 96 and 213.3 kMc/s. The resonance frequency was found to be given by $\nu = 264 B_{5/2}$ (T/67.7) kMc/s in zero field. The line width and g-value were obtained, and the value of $(2H_E H_A)^{1/2}$ was found to equal 9 x 10^4 oersted, in good agreement with a calculation by Keffer. E.P.Wohlfarth

538.221

2420. ANTIFERROMAGNETISM AND ANTIFERROMAGNETIC RESONANCE IN $CuBr_2.2H_2O$ AT 9800 Mc/sec. M.Date.
Phys. Rev., Vol. 104, No. 3, 623-4 (Nov. 1, 1956).

Antiferromagnetic resonance was observed in a single crystal of $CuBr_2.2H_2O$ at liquid helium temperature. This crystal shows an isomorphous structure with that of $CuCl_2.2H_2O$ and the experimental results are analogous to those for the latter. However, the resonance field shifts to the higher field side and this is considered to be the result of a stronger molecular field than that of $CuCl_2.2H_2O$. The Néel point of $CuBr_2.2H_2O$ was inferred to lie between 5°K and 6.5°K. A.

538.221

2421. ANISOTROPY CONSTANTS AND g VALUE OF NICKEL FERRITE. D.W.Healy, Jr and R.A.Johnson.
Phys. Rev., Vol. 104, No. 3, 634-6 (Nov. 1, 1956).

Presents experimental data from 4°K to 300°K over a frequency range of 7900 to 11 500 Mc/s. The observed anisotropy constants agree with those measured by Yager, Galt, and Merritt at K band on the same crystal. Previous measurements by Healy at X band are considerably different, presumably as a result of variations between different single-crystal samples representing the same ferrite. The measured g values show a significant variation with frequency. This has not been observed in previous measurements on single crystals. A.

538.221 : 539.234

2422. MAGNETIC DOMAINS IN EVAPORATED THIN FILMS OF NICKEL–IRON. C.A.Fowler, Jr, E.M.Fryer and J.R.Stevens.
Phys. Rev., Vol. 104, No. 3, 645-9 (Nov. 1, 1956).

The longitudinal Kerr magneto-optic technique proves to be well suited for the observation of domains in evaporated ferromagnetic thin films. In a series of six films of NiFe ranging in thickness from 20 000 angstroms to 500 angstroms, domain patterns have been photographed in all but the two thickest. Many features of domain structure, familiar in bulk single crystals, have been observed in the films. Certain unusual features of domain behaviour appear characteristic of the thinnest specimens and have also been photographed. Complexities in many of the patterns, uncorrelated with change of film thickness, are probably due to uncontrolled physical factors connected with the manufacture and the preservation of the specimens. The necessity of careful control of such factors for quantitative domain investigation is emphasized. A.

538.221 : 548.74

2423. MAGNETIC STRUCTURES OF THE POLYMORPHIC FORMS OF MANGANOUS SULFIDE. L.Corliss, N.Elliott and J.Hastings.
Phys. Rev., Vol. 104, No. 4, 924-8 (Nov. 15, 1956).

Manganous sulphide exists in three polymorphic forms. There are two cubic modifications, α-MnS having the rock salt structure and β-MnS with the zinc blende structure. The third form is hexagonal β-MnS with the wurtzite structure. The magnetic susceptibilities of all three forms and the antiferromagnetic structures, as determined by neutron diffraction, are reported. α-MnS exhibits ordering of the second kind, in agreement with earlier work. The spin direction, however, is found to be in the ferromagnetic (111)

sheets rather than along cube edges. In the cubic β-MnS case, the magnetic structure is the hitherto unobserved "improved ordering of the first kind" proposed by Anderson. The spin direction is normal to the unique cubic axis. The hexagonal β-MnS antiferromagnetic structure can be derived from the cubic β-MnS by stacking the close-packed (111) sheets of the zinc blende form according to the scheme ABA — appropriate to hexagonal close-packing. The magnetic unit cell is orthohexagonal with $a_0' = a_0\sqrt{3}$, $b_0' = 2a_0$, $c_0' = c_0$, where the unprimed symbols refer to the original hexagonal cell. The spin direction is normal to the (011) plane. These magnetic structures are discussed on the basis of an indirect exchange coupling mechanism. A.

538.221

2424. MAGNETIC SUSCEPTIBILITY OF NiO AND CoO SINGLE CRYSTALS. J.R.Singer.
Phys. Rev., Vol. 104, No. 4, 929-32 (Nov. 15, 1956).

The magnetic susceptibility of a NiO single crystal grown by the flame fusion method was found to be isotropic below the Curie temperature as it is for the case of powdered material. Such characteristics can be explained by twinning or domain structure within the crystal. Stressing the crystal along a [111] direction, while annealing, produces an anisotropic susceptibility with the maximum and minimum values found when the applied field was parallel and perpendicular, respectively, to the direction of stress. By using the Van Vleck theory, the results can be explained on the basis that the stress rotates some of the atomic spins from the direction of the [111] stress axis to the perpendicular planes. An assignment of spin direction to (111) planes of each domain agrees with the most recent neutron diffraction interpretation. The antiferromagnetic susceptibility of a single crystal of CoO was found to decrease when measured along one cubic edge and remain approximately constant along the other two [100] directions for temperatures down to 77°K. At liquid helium temperatures the susceptibility increases for all [100] directions. A.

538.221

2425. A COMPARISON OF MAGNETIC VISCOSITY IN ISOTROPIC AND ANISOTROPIC HIGH COERCIVITY ALLOYS. R.Street and J.C.Woolley.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1189-98 (Dec., 1956).

Measurements of magnetic viscosity in equiaxed isotropic and anisotropic Alcomax III specimens have been made, the anisotropy was induced by cooling the material, from the single phase region, in a magnetic field of 4000 Oe. The results are discussed in terms of the concept of the thermal activation of irreversible domain boundary wall movements. Comparisons of the results of measurements on anisotropic and isotropic specimens are in reasonable agreement with theoretical predictions. A.

538.221

2426. THE SUSCEPTIBILITY AND MAGNETIC SPECIFIC HEAT OF POTASSIUM FERRICYANIDE AT LOW TEMPERATURES. F.R.McKim and W.P.Wolf.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1231-6 (Dec., 1956).

The temperature variation of the susceptibility of single crystals of potassium ferricyanide has been measured between 20° and 1°K, using an a.c. mutual inductance method. The results of measurements along each of the three crystalline axes were fitted to expressions of the form $\chi_X = (\lambda_X/T)(1 + \Delta_X/T + \ldots)$ and values of λ_X and Δ_X deduced. It was found that the effect of higher order terms was very small. The magnetic specific heat was measured at 1.05°K using the relaxation method. An attempt was made to relate the values of Δ to the measured specific heat and paramagnetic resonance line width, on the basis of exchange interaction with n equivalent nearest neighbours. It was found, however, that only approximate agreement could be obtained, and this with the rather small value of n = 2. A.

538.221 : 538.63

2427. FERROMAGNETISM OF THIN NICKEL FILMS AT LOW TEMPERATURES. A.Dupré.
Verhandl. K. Vlaamse Acad. Wetensch., No. 52, 49 pp. (1955). In Dutch.

Reports results of measurements of the change of resistance of evaporated Ni films in magnetic fields up to about 6×10^3 oersted and at temperatures up to about 100°K. The coercive force is deduced as being that where $\Delta R/R$ is a maximum. Its values were obtained parallel and perpendicular to the film surface (occasionally also at intermediate angles) as a function of temperature. The structure of the films was investigated by electron diffraction. E.P.Wohlfarth

538.222

2428. INVESTIGATION OF THE PARAMAGNETISM OF CERTAIN FERRITES. F.Gal'perin, G.Dmitrakova and L.Molodtsova.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 833-4 (1954). In Russian.

Curves were obtained for the variation of $1/\chi_\mu$ and α with temperature for ferroxdure, vectolite, and ferrites based on Mn, Co, Mg, Co—Mn, Co—Ni. For the cobalt ferrite and for vectolites containing Co, anomalous behaviour was found in that the susceptibility increased with temperature. A similar result had been found earlier (Abstr. 3266/1950) for cobalt telluride. At higher temperatures the $1/\chi_\mu$—T curve is found to be very close to a hyperbola and it is suggested that the Néel law (Abstr. 3388/1948) has no valid foundation. C.R.S.Manders

538.222

2429. ROTATION COOLING IN CERIUM MAGNESIUM NITRATE. J.C.Wheatley and T.L.Estle.
Phys. Rev., Vol. 104, No. 1, 264 (Oct. 1, 1956).

The absolute temperature T was obtained for a range of values of field strength H ($1.27 - 4.10 \times 10^3$ oersted) and of the angle θ between H and the trigonal axis; T was found to be proportional to $\sin\theta$. Values of $g_\parallel$ and $g_\perp$ were obtained and it was found that $g_\parallel/g_\perp$ is very small. E.P.Wohlfarth

538.24 : 539.234

2430. MAGNETIZATION REVERSAL IN THIN FILMS. D.O.Smith.
Phys. Rev., Vol. 104, No. 5, 1280-1 (Dec. 1, 1956).

The magnetization reversal of thin films ($\cong$ 1000 A thick) of 80-20 Permalloy has been studied in a strip transmission line. These films are evaporated on to a heated glass substrate in the presence of an orienting field. Magnetization reversal along the axis of initial orientation takes place in times less than 20 mμsec in any reversing field large enough to overcome the orienting energy. The switching coefficient S_W is defined by $S_W = H_m\tau$, with τ the reversal time and H_m the reversing field. The experiment gives $H_m = 1$ Oe and $\tau \leqq 2 \times 10^{-8}$ sec, from which $S_W \leqq 2 \times 10^{-8}$ Oe-sec. Reversal by rotation of the magnetization as a whole in the plane of the film yields a model which is consistent with the observed reversal times. Preliminary measurements of the initial permeability perpendicular to the orientation axis have been carried out to 2000 Mc/s and do not yet reveal the expected frequency dispersion of the initial permeability. This is an indication that S_W may be another order of magnitude smaller than reported here. A.

538.24

2431. THE NOISES OF CYCLIC REVERSAL OF MAGNETIZATION OF FERROMAGNETICS. F.V.Bunkin.
Zh. tekh. Fiz., Vol. 26, No. 8, 1790-8 (1956). In Russian.

A theoretical paper in which the e.m.f. included in a coil as a result of reversal of magnetization of the ferromagnetic core is considered as a random superposition of elementary perturbations. The author discusses the correlation functions and the spectrum intensity of noises due to reversal of magnetization which enables calculation to be made of the particular noises of various coils with ferromagnetic cores, chokes, transformers, magnetic amplifiers etc. The case of the signal-to-noise ratio of the output of a transformer is considered more fully. C.R.S.Manders

538.245

2432. OBSERVATION OF MAGNETIC DOMAINS IN ELECTRON SHADOW PHOTOGRAPHS. M.Blackman and E.Grünbaum.
Nature (London), Vol. 178, 584-5 (Sept. 15, 1956).

A 46 keV electron beam is passed close to the surface of an unmagnetized Co crystal. The leakage field originating from the oppositely magnetized domains deflects the electrons, and a shadow photograph shows a series of cusps, the dimensions of which lead to domain spacings between 40 and 240 μ. E.P.Wohlfarth

538.245

2433. AN ANALYSIS OF THE MAGNETIZATION PROCESSES IN IRON SINGLE CRYSTALS BY AN ELECTRICAL METHOD. R.Parker.
Phil. Mag. (Eighth Ser.), Vol. 1, 1133-46 (Dec., 1956).

Döring's theory of the anisotropy of electrical resistivity of ferromagnetics is applied to the published magnetoresistance data of single crystals of iron. The theory is shown to be in good agreement with experiment and the five anisotropy coefficients for iron are evaluated. It is suggested that a study of the magnetoresistance as a function of magnetization may be used to obtain information concerning the magnetization processes in ferromagnetic crystals of cubic symmetry. An analysis has been made of the measurements reported by Kuwahara on single crystal strips of iron. In certain favourable

cases the actual magnetization process can be inferred from a number of plausible alternatives by a consideration of the electrical data. For other specimens an estimate of the domain vector orientation in the demagnetized state is obtained. The relative advantages of the electrical method are discussed. A.

538.245 : 548.735.7

2434. THE INFLUENCE OF THE CRYSTALLITE SIZE ON THE COERCIVITY OF ELECTROLYTICALLY DEPOSITED AND EVAPORATED FILMS OF NICKEL AND IRON. L.Reimer.
Z. Naturforsch., Vol. 11a, No. 8, 649-55 (Aug., 1956). In German.

The crystallite size of electrolytically deposited layers is determined by the crystal structure of the substrate, while with evaporated layers it is determined by the crucible temperature. Both types of layer were examined in an electron microscope and the coercivities of the layers were measured. By extrapolating back to a single-domain layer the coercivity values for the materials could be determined, as suggested by Néel and by Kittel. C.A.Hogarth

538.245 : 538.63

2435. ON THE THEORY OF THE HALL EFFECT IN FERROMAGNETICS. N.S.Akulov and A.V.Cheremushkina,
Zh. éksper. teor. Fiz., Vol. 31, No. 1(7), 152-3 (1956). In Russian.

The Hall constants of Fe, Ni and a 46% Ni + 53.2% Fe alloy have been measured as a function of resistivity and the results analysed, together with those of other authors, in an attempt to find a correlation. An empirical relationship is deduced: $R - R_0 = a_0(\rho - \rho_0) + a_1\rho(\rho - \rho_0)$ where R is the Hall constant and ρ resistivity. This holds only down to about 100°K, where the anomalous negative temperature coefficient of R destroys its validity. J.B.Arthur

538.245

2436. TEXTURE AND MAGNETIZATION CURVES OF SILICON–IRON. D.Ganz and R.Brenner.
Z. angew. Phys., Vol. 8, No. 10, 502-5 (Oct., 1956). In German.

The magnetization curves, in fields up to 400 oersteds, of silicon–iron with a nominal (110) [001] texture but with various degrees of deviation from this ideal have been calculated. From these results, and etch-pit determinations of the texture, the magnetization curves for two specimens of silicon–iron have been calculated and compared with the observed curves. The agreement is, in general, good and is better for the more highly oriented sample. The discrepancies are attributed to demagnetizing fields set up by the mis-oriented crystals, and to the resultant flux distortion. A.E.De Barr

ELECTROMAGNETISM. ELECTRODYNAMICS 538.3/.5

538.3

2437. INTEGRABILITY CONDITIONS FOR THE SINGULAR ELECTROMAGNETIC FIELD. M.Cahen.
C.R. Acad. Sci. (Paris), Vol. 243, No. 9, 737-40 (Aug. 27, 1956). In French.

For earlier work see Abstr. 9395 (1954).

538.3

2438. ON THE NOTION OF INFINITELY THIN SCREENS OF INFINITE CONDUCTIVITY. P.Poincelot.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1616-18 (Nov. 19, 1956). In French.

Some remarks are made concerning the behaviour of such screens in an electromagnetic field. Diffraction is briefly discussed. L.S.Goddard

538.3 : 534.2

2439. NORMAL MODES CHARACTERIZING MAGNETOELASTIC PLANE WAVES. A.Baños, Jr.
Phys. Rev., Vol. 104, No. 2, 300-5 (Oct. 15, 1956).

The general theory of magnetohydrodynamic waves in an ideal conducting fluid embedded in a uniform field of magnetic induction, and the application of the theory to the systematic analysis of the various modes of propagation in incompressible fluids have been presented by the author in two earlier papers. The techniques developed there have now been extended to the study of homogeneous plane waves in an unbounded conducting solid. It is found that, in the presence of a uniform magnetic field the elastic medium sustains five distinct modes of propagation as already pointed out by Knopoff. The first two modes are pure shear waves, one of which is a slightly attenuated shear mode with phase velocity modified anisotropically by magnetoelastic coupling, whereas the companion shear mode is highly attenuated and exhibits a propagation constant which is essentially that of an electromagnetic wave of the same frequency. The remaining three modes are shear–compression waves of which one mode exhibits a phase velocity intermediate between the phase velocity of shear and compressional waves, the second mode has a phase velocity exceeding that of compressional waves and the third shear–compression mode is again highly attenuated with the propagation characteristics of an electromagnetic wave. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS 538.56

538.56 : 532.5

2440. STRUCTURE OF MAGNETOHYDRODYNAMIC SHOCK WAVE IN A PLASMA OF INFINITE CONDUCTIVITY. W.Marshall.
Phys. Rev., Vol. 103, No. 6, 1900 (Sept. 15, 1956).

Sen's results (Abstr. 3859/1956) are modified for the case of a highly ionized plasma, the Prandtl number in this case being much less than that used by Sen. Shock widths are found to be very much greater, and for stronger shocks the front is made up of two distinct regions. R.A.Newing

538.56 : 535.11 : 536.33 : 534.23

SELF-ABSORPTION OF A RADIATING SPHERE. See Abstr. 1979-80

538.561 : 535.33

2441. HETERODYNING OF LIGHT. S.I.Borovitskiĭ and G.S.Gorelik.
Uspekhi fiz. Nauk, Vol. 59, No. 3, 543-52 (1956). In Russian.

The effect consists essentially of mixing two optical spectral lines whose frequencies differ by an amount which falls within the region of very high radiofrequencies. The authors review the theory and discuss the experimental equipment. C.R.S.Manders

538.565 : 621.372.413

2442. ON THE COUPLING BETWEEN TWO CAVITIES. R.N.Gould and A.Cunliffe.
Phil. Mag. (Eighth Ser.), Vol. 1, 1126-9 (Dec., 1956).

C and C' are two electromagnetic cavity resonators which communicate with each other through an iris. The present note describes a general method of calculating the electric and magnetic field configurations and the associated eigenvalues of this compound system, in terms of certain orthogonal functions of the separate cavities C and C' formed when the iris is closed by a thin partition. A.

538.566 : 537.312.62

2443. TRANSMISSION OF SUPERCONDUCTING FILMS AT MILLIMETER-MICROWAVE AND FAR INFRARED FREQUENCIES. R.E.Glover, III and M.Tinkham.
Phys. Rev., Vol. 104, No. 3, 844-5 (Nov. 1, 1956).

The ratio of transmission of microwave and infrared radiation by a thin lead film (20 A thick) in the superconductive and normal states has been measured. In the microwave region ($\nu < kT_c/h$) this ratio is much less than 1 and rises with frequency; in the infrared region the ratio falls with increasing frequency, from about 1.5 at $\nu = 5kT_c/h$ to just about 1 at $\nu = 20kT_c/h$. Less accurate measurements on tin films give qualitatively similar results. D.Shoenberg

538.566

2444. RESONANCE AT THE SURFACE OF A REFLECTION GRATING. L.I.Deryugin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 2, 203-6 (1954). In Russian.

The special case in which electromagnetic waves of wavelength λ are incident normally on a reflection grating with period $2l$ and where $2l = r\lambda$ (r being an integer) is examined theoretically. Expressions for the reflecting power and for the scattering are obtained for varying depths of the rulings. A.L.Mackay

538.566

2445. CONTROL OF A BIREFRINGENT QUARTER-WAVE PLATE BY A METHOD OF DISPLACEMENT OF FRINGES IN THE 3 cm BAND. R.Servant.
J. Phys. Radium, Vol. 17, No. 6, 3 S-4 S (June, 1956). In French.

A method is described of accurately determining the characteristics of a 3 cm quarter-wave plate for use in dispersion measurements. A.J.Egginton

538.566 : 534.2 : 530.145

2446. HIGH-FREQUENCY SCATTERING. Tai Tsun Wu.
Phys. Rev., Vol. 104, No. 5, 1201-12 (Dec. 1, 1956).

The simplest problems of this sort, in which the obstacle is either a circular cylinder or a sphere, are treated. The treatment is limited to the total scattering cross-sections, even though the method is by no means restricted in this way. The specific problems treated include the scattering of a plane electromagnetic wave by a perfectly conducting circular cylinder (two possible polarizations) or a perfectly conducting sphere, the acoustic scattering by a rigid sphere, and the quantum-mechanical scattering by an impenetrable sphere. By considering the creeping waves as defined on the universal covering space, the scattering cross-sections of a circular cylinder may be expressed by asymptotic expansions for vanishingly small wavelengths. Analogous calculations yield the corresponding results for a sphere. It turns out, as expected, that the resulting expressions are accurate even for fairly large wavelengths. The first six terms of the asymptotic series are explicitly found in each case. In conclusion, the application of the method to the determination of the approximate current distribution on the obstacle is considered briefly; also some generalizations about the scattering cross-section are conjectured. A.

538.566

2447. THE SCATTERING OF ELECTROMAGNETIC WAVES BY CONDUCTING SPHERES AND DISCS. J.S.Hey, G.S.Stewart, J.T.Pinson and P.E.V.Prince.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 1038-49 (Oct., 1956).

A laboratory method is described for measuring the returned signal scattered from an object in an electromagnetic field. Measurements on conducting spheres and disks are compared with theoretical formulae. A new computation of the scattering function for conducting spheres is tabulated. A.

538.566 : 621.396.11

2448. THE DIFFRACTION OF AN ELECTROMAGNETIC WAVE BY A CIRCULAR APERTURE. R.F.Millar.
Proc. Instn Elect. Engrs, Monogr. 196R, publ. Sept., 1956 (Vol. 104C, 87-95).

Republication of the monograph abstracted in Abstr. 7556 (1956).

538.566.2 : 537.525

2449. ON WAVE PROPAGATION IN A PLASMA BETWEEN TWO INFINITE CONDUCTING PLANES IN THE DIRECTION OF AN APPLIED EXTERNAL MAGNETIC FIELD. W.O.Schumann.
Z. angew. Phys., Vol. 8, No. 10, 482-5 (Oct., 1956). In German.

Results previously obtained for an infinite field (Abstr. 1200/1951) are extended to a finite one. In a plasma between two conducting planes there are, in general, three frequency ranges in which the propagation constant is imaginary. If the plasma moves in the direction of an applied magnetic field, the excitation of e.m. waves in these ranges appears possible. L.Pincherle

538.566.2 : 621.372.21

2450. THE PROBLEM OF PULSE TRANSMISSION BY DISCONTINUOUS ELECTROMAGNETIC WAVES IN DIELECTRIC MEDIA. G.Marx and K.Nagy.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 2, 79-81 (1956). In German.

A.Rubinowicz (Abstr. 4525/1956) has given an expression for a field impulse deduced from the integral form of the conservation law. In the case where the surface current and surface charges vanish and the surface of discontinuity is propagated with the velocity of light, then the discontinuities in electric and magnetic field strengths in a homogeneous medium have an impulsive form. The source of this phenomenon is not understood and the present paper examines the case of media with both conduction and elastically-bound electrons. It is concluded that the results of Rubinowicz are consistent with the conditions in the media. S.C.Dunn

538.566.2 : 551.594.22

2451. LIGHTNING AND THE PROPAGATION OF AUDIO FREQUENCY ELECTROMAGNETIC WAVES. Ya.L.Al'pert.
Uspekhi fiz. Nauk, Vol. 60, No. 3, 369-89 (1956). In Russian.

The difficulties are first discussed of treating theoretically the problems which arise with the 300-30 000 c/s propagated in a spherical waveguide, one wall of which is the ionosphere of not-too-well-known properties and the other is the "perfectly" reflecting ground. Lightning sets up e.m. waves of low frequency in a burst of atmospherics. Results obtained in determinations of the shape, and the harmonic analysis, of atmospherics are discussed, also variation of the velocity of propagation of such waves with wavelength. C.R.S.Manders

538.566.3

2452. THE INTENSITY OF THE SO-CALLED PEDERSEN RAY. K.Rawer.
C.R. Acad. Sci. (Paris), Vol. 243, No. 11, 797-8 (Sept. 10, 1956). In French.

Assuming a certain ionosphere model, numerical calculations have been made of the total attenuations of the normal and Pedersen (high-angle) rays for a transmission distance of 2000 km, considering the relative contributions of geometrical decrement, non-deviative D-region absorption, and deviative absorption in the E-region. It is shown how, for the lower frequencies, the greater geometrical decrement of the Pedersen ray is offset by the reduced deviative absorption, so that the net intensity of the Pedersen ray can exceed that of the normal ray. G.M.Brown

538.566.3 : 621.396.11

2453. A STUDY OF THE LIMITING POLARIZATION OF HIGH FREQUENCY RADIO WAVES REFLECTED VERTICALLY FROM THE IONOSPHERE. B.Landmark.
Geofys. Publ., Vol. 19, No. 7, 49 pp. (1955).

A detailed theoretical and experimental analysis. It is shown that both the ray and wave treatments of the magneto-ionic theory predict that h.f. radio waves reflected vertically from the ionosphere should be nearly circularly polarized for the geomagnetic conditions of Norway. The effects on the polarization ellipse of horizontal gradients and irregularities are discussed and it is concluded that departures from circularity may be explained in terms of a statistical theory of limiting polarization in which the reflected wave is treated as the sum of rays reflected within a cone about the vertical direction, the phases of the rays being distributed at random. Details are given of a radio-polarimeter developed in Norway and of results obtained with it on the z-component, which bear out the statistical theory developed. G.M.Brown

538.567 : 537.311.33

2454. THE EFFECT OF HIGH ELECTRIC FIELDS ON THE ABSORPTION OF GERMANIUM AT MICROWAVE FREQUENCIES. J.B.Arthur, A.F.Gibson and J.W.Granville.
J. Electronics, Vol. 2, No. 2, 145-53 (Sept., 1956).

The paper describes the observation of a new effect in n-type germanium; namely a decrease in the absorption of microwave radiation on the application of an external electric field. The effect is due to the tendency for the electron drift velocity to saturate at high electric fields. The variation in electron drift velocity with field is obtained from the experimental results. Significant departures from Ohm's law are observed at electric fields as low as 10 V cm^{-1}. A.

538.569.4

2455. SPECTROSCOPIC SPLITTING FACTORS FOR IRON AND SILICON–IRON. G.S.Barlow and K.J.Standley.
Proc. Phys. Soc. B., Vol. 69, Pt 10, 1052-5 (Oct., 1956).

Microwave resonance absorption of polycrystalline steel and silicon–iron disks has been measured. In calculating the spectroscopic splitting factor, g, it is not adequate to assume that the average values of algebraic functions, ϕ and ψ, in the Kittel equation are zero. Extrapolations of data from crystalline specimens, using the highest available frequencies, should give the most accurate results. For iron, $g = 2.09 \pm 0.02$. A.G.Gaydon

MOLECULAR AND ATOMIC STRUCTURE

539.1

THEORY OF SOLID STATE 539.11

539.11 : 536.7

2456. SPECIFIC HEATS OF COMPRESSIBLE LATTICES AND THE THEORY OF MELTING. C.Domb.
J. chem. Phys., Vol. 25, No. 4, 783 (Oct., 1956).

Derives from the elementary properties of the partition function of the Ising model a result obtained by Rice (Abstr. 11256/1954), that a transition with an infinite specific heat in an incompressible lattice becomes a first order transition in a compressible one. E.P.Wohlfarth

539.11

2457. THEORETICAL CALCULATIONS ON SOLID ARGON. C.Domb and I.J.Zucker.
Nature (London), Vol. 178, 484 (Sept. 1, 1956).

The experimental results of Abstr. 2117 (1956) are used to test

the applicability of the intermolecular potential energy $\epsilon(r) = \lambda/r^{13} - \mu/r^6$ where $\lambda = 1.63 \times 10^{-7}$ A.^{12} erg and $\mu = 1.05 \times 10^{-10}$ A.^{6} erg. For the calculation of α and γ Henkel's approximation (Abstr. 5548/1955) was used and there is good agreement between the experimental and calculated values. A further check on the potential is provided by the Debye θ value which for above $\epsilon(r)$ is equal to 80°K in agreement with Hill's experimental specific heat value. S.Weintroub

539.11

2458. SPECTRAL DIFFUSION IN MAGNETIC RESONANCE. A.M.Portis.
Phys. Rev., Vol. 104, No. 3, 584-8 (Nov. 1, 1956).

Electron spin–spin interaction is discussed for the case of strong hyperfine broadening. The hyperfine interaction is represented by a resonance spectrum of width $\Delta\omega$ and the electron interactions, which are taken to be dipolar, are treated by time-dependent perturbation theory. A characteristic relaxation time for electron spins, $\tau_s = \Delta\omega/\Delta^2$, is found, where Δ is a measure of the strength of the dipolar interaction. The time-dependent theory suggests a modification of the Bloch equations to give a phenomenological description of systems of this kind. Spin–spin relaxation is represented by a term which gives diffusion of spin excitation through the resonance spectrum. Slow passage, rapid passage, and free relaxation are considered by using the modified equations. A.

539.11 : 536.75

2459. MAGNETIC RESONANCE AND MINIMUM ENTROPY PRODUCTION. MACROSCOPIC EQUATIONS OF MOTION. R.K.Wangsness.
Phys. Rev., Vol. 104, No. 4, 857-66 (Nov. 15, 1956).

See Abstr. 2993(1956). A generalization and modification of the previous discussion is given. By requiring that the steady states obtained in magnetic resonance experiments correspond to the minimum rate of entropy production, a condition is obtained which must be satisfied by the equation describing the rate of change of the spin density matrix due to interactions with the surroundings. This enables one to test the adequacy of the form of equations proposed to describe relaxation phenomena in resonance by finding whether they satisfy this condition, and, conversely, one can derive directly possible forms of macroscopic terms from its solutions. As examples of this procedure, the modified Bloch equations are derived, and the equation of Codrington, Olds, and Torrey is shown to be consistent with this condition. A corrected form of the Wangsness–Bloch equation for the rate of change of the density matrix is shown to be more adequate for arbitrary values of the fields, and the justification of the modified Bloch equations is also given in this way. Other examples, as well as the general relation of this work to irreversible thermodynamics, are discussed, and a generalized reciprocal relation is derived. The steady-state solutions of the new equations of motion are given in an appendix. A.

539.11 : 539.32

2460. CALCULATION OF THE ELASTIC SHEAR CONSTANTS OF MAGNESIUM AND MAGNESIUM ALLOYS. J.R.Reitz and C.S.Smith.
Phys. Rev., Vol. 104, No. 5, 1253-9 (Dec. 1, 1956).

Leigh's calculation of the elastic shear constants of aluminium are extended to include crystals of lower symmetry, and the results are used to interpret the constants of pure magnesium and dilute magnesium alloys. The requirement that pure magnesium be in equilibrium with respect to shears that change the c/a ratio of this hexagonal crystal is consistent only with the assumption that electron overlap has already occurred across the Brillouin zone faces perpendicular to the c axis, a result which is at variance with the usual assumptions for this metal. Assuming c overlap and one other type of electron overlap in the pure metal, it is found that the total number of overlap electrons (or, equivalently, the number of holes) is 1.70×10^{21} per cm^3, i.e. 2% of the valence electron density. The overlap which appears at an electron/atom ratio of 2.01 is assumed to be an overlap in the equatorial plane of Brillouin zone; this overlap produces an abrupt change in one of the shear constants as the electron/atom ratio is increased beyond 2.10, a behaviour of the type predicted by Leigh for aluminium–zinc alloys. The abrupt change in the constant is characteristic of T = 0°K, however; at room temperature, the predicted effect is much more gradual and is found to agree with the experimental results. A.

539.11

2461. HALOGEN BAND IN SODIUM CHLORIDE. R.C.Casella.
Phys. Rev., Vol. 104, No. 5, 1260-3 (Dec. 1, 1956).

The approximation of tight binding is employed to determine a minimum for the width of the halogen band in NaCl. Approximate curves of the one-electron energy E v. wave number k are provided for values of K lying along lines of high symmetry in the first Brillouin zone. A minimum width of about 1.0 eV is obtained. A.

539.11 : 548.7

2462. ON THE THEORY OF TRANSITIONS IN SOME MOLECULAR CRYSTALS. II. F.W.de Wette.
Physica, Vol. 22, No. 8, 644-6 (Aug., 1956).

For Pt I, see Abstr. 4825 (1956). Calculations by the central field approximation for the f.c.c. structure on N_2 and CO predict a transition from hindered to free rotation at temperatures near the actual f.c.c.–h.c.p. transitions, suggesting that these may actually be transitions from orientational order in f.c.c. to disorder in h.c.p. Lack of information on the zero-point configuration prevents analogous calculation for h.c.p., this approximation only distinguishing the two lattices by orientational configuration. J.Hawgood

539.11

2463. COLLECTIVE ENERGY LOSSES IN SOLIDS. D.Pines.
Rev. mod. Phys., Vol. 28, No. 3, 184-98 (July, 1956).

The collective character of the characteristic energy losses of fast electrons scattered by thin solid films is discussed. For energy transfers of order 10 to 25 eV the energy will normally be absorbed by the valency electrons. The excitation spectrum of the valency electrons is characterized by a family of one particle energy differences corresponding to electronic transitions within the same band, or from one band to another. If however the Coulomb interaction of the valency electrons influences this excitation spectrum, collective oscillations of frequency higher than any normal individual frequency occur, and this frequency depends only on the electron charge, mass, and density in the solid. The term "plasmon" is introduced to describe the quantum of elementary excitation associated with the high frequency collective motion. Mathematical analyses are presented for the plasmon dispersion relation in solids and for the mechanism by which a plasmon is excited by a fast charged particle; the results are compared with existing experimental data and suggestions for future work are offered. C.A.Hogarth

539.11 : 538.113

THEORY OF CYCLOTRON RESONANCE IN METALS. See Abstr. 2395

MOLECULES 539.13

539.13

2464. INTERMOLECULAR POTENTIALS OF THE INERT GASES FROM SOLID STATE DATA. I.J.Zucker.
J. chem. Phys., Vol. 25, No. 5, 915-17 (Nov., 1956).

The constants α and β appearing in assumed interatomic energies of the type $\alpha/r^m - \beta/r^6$, $m > 6$, have been calculated for the rare gases for various m, using solid state data only. Using these results the equations of state of these gases in the solid phase have been calculated, and compared with recent experimental data. For neon, m = 14 gave excellent agreement, while for krypton and argon m = 12 gave reasonable agreement with experiment. A.

539.13

2465. LONG-RANGE INTERMOLECULAR FORCES. J.S.Dahler and J.O.Hirschfelder.
J. chem. Phys., Vol. 25, No. 5, 986-1005 (Nov., 1956).

The calculation of long-range intermolecular forces is systematized so as to apply to molecules in electronically excited states where resonance as well as electrostatic, induction and dispersion forces are encountered. Especial attention is given to deviations from the pairwise additivity of the energy of interaction of systems involving three or more molecules. Three types of nonadditivity are found. These are due to resonance degeneracy, molecular degeneracy, and multipole-induction effects. The following specific examples are considered: (a) the interaction energy of three hydrogen atoms, two in the ground state and the third in the first excited state; (b) the interaction of two polar, nondegenerate molecules with a hydrogen atom in its first excited state; and the multipole induction nonadditive interaction between (c) three polar molecules, and (d) three quadrupolar molecules. Throughout these calculations the third and higher order terms in the perturbation are neglected. A.

539.132

2466. VALIDITY OF THE ASSUMPTION OF TWO-BODY INTERACTIONS IN MOLECULAR PHYSICS. L.Jansen and R.T.McGinnies.
Phys. Rev., Vol. 104, No. 4, 961-6 (Nov. 15, 1956).

The treatment of three-body van der Waals forces between hydrogen or helium atoms, given previously (Abstr. 3056/1956), is extended to the heavy rare gas atoms. Two of the three atoms are supposed to be close together (e.g., nearest neighbours in a crystal), whereas the third atom is considerably farther away. Expressions are given for the induced dipole-dipole and dipole-quadrupole components of the field. The electronic charges in the atoms are represented by Gaussian distribution functions. The results are applied to a determination of the most stable crystal structure of the heavy rare gases at absolute zero temperature (excluding zero-point energy); it is found that the face-centred cubic crystal is favoured over the hexagonal close-packed by about one-tenth of one percent of the van der Waals cohesive energy, if the first and second shells of neighbours are excluded from the region of summation for the third atom. If this restriction is dropped, then the difference between the two structures vanishes, while the effect itself rises abruptly and very steeply. The effect of three-body interactions in general is to weaken the attractive forces in the crystalline state. Under the above restriction, the relative magnitude of these interactions is 20% of the van der Waals cohesive energy for xenon. The three-body forces vanish identically if the Gaussian goes over into a Dirac δ function. A.

539.132

2467. ISOTROPIC HYPERFINE INTERACTIONS IN AROMATIC FREE RADICALS. S.I.Weissman.
J. chem. Phys., Vol. 25, No. 5, 890-1 (Nov., 1956).

It is shown, by a procedure similar to one used by Abragam, Horowitz,and Pryce in their studies of hyperfine structure in paramagnetic ions and atoms, that configurational interaction may contribute to the isotropic hyperfine interaction in free radicals. For a configurational admixture of the type $(\sigma_B)^2(\pi) + \lambda(\sigma_B)(\sigma_A)(\pi)$, the hyperfine interaction is $32\pi/3\sqrt{6}\mu_\eta\mu_e\lambda\sigma_B(r_\eta)\sigma_A(r_\eta)$ where μ_e and μ_η are magnetic moments of the electron and the nucleus η, and $\sigma(r_\eta)$ is the magnitude of the orbital σ at the position of the nucleus. Since the hyperfine coupling is linear in λ, only small admixtures of excited configurations are required to account for the proton hyperfine splittings observed in aromatic free radicals. A.

539.132

2468. VARIATIONAL CALCULATIONS OF MAGNETIC SHIELDING OF PROTONS IN THE HYDROGEN MOLECULE. T.P.Das and R.Bersohn.
Phys. Rev., Vol. 104, No. 3, 849 (Nov. 1, 1956).

Using a variational function of Tillieu and Guy (Abstr. 8910/1956) good results for the second-order paramagnetic term are obtained. G.E.Brown

539.132

2469. INFLUENCE OF VIBRATION–ROTATION INTERACTION ON THE INTENSITIES OF PURE ROTATION LINES OF DIATOMIC MOLECULES. R.Herman and R.J.Rubin.
Canad. J. Phys., Vol. 34, No. 11, 1119-25 (Nov., 1956).

The magnitude of the effect of the vibration–rotation interaction on the intensities of pure rotation lines of diatomic molecules has been calculated for two different molecular models, the anharmonic oscillator and the rotating Morse or Pekeris oscillator. The intensity correction for the anharmonic oscillator has been obtained by adapting the contact transformation formalism for calculating second-order corrections to the energy to the calculation of first-order corrections to the matrix elements of the electric moment as suggested by H.H.Nielsen. The results obtained are also in complete agreement, to first order, with the results obtained earlier by Herman and Wallis for the 1-0 and 2-0 vibration–rotation line intensities. A.

539.132

2470. RELATION BETWEEN ANHARMONICITY CONSTANTS AND THE FREQUENCIES OF ISOTOPIC MOLECULES. L.M.Sverdlov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 451-4 (1954). In Russian.

An equation is deduced for the relation between the anharmonicity constants of isotopic diatomic molecules (HD, HT, etc.), and also between the vibration frequencies of isotopic molecules (not necessarily diatomic). The accuracy of the equation is tested out on published figures for the vibration frequencies of the various deuterides of benzene. R.C.Murray

539.132

2471. THIRD-ORDER ANHARMONIC RESONANCE IN HCN. H.Hanson and H.H.Nielsen.
J. chem. Phys., Vol. 25, No. 3, 591 (Sept., 1956).

Theoretical discussion of displacement of certain polyad vibrational levels from predicted positions (Abstr. 3141/1953). The relative magnitudes of the shifts and their non-occurrence in similar levels are explained by considering third-order terms in the potential energy. J.Hawgood

539.132

2472. COMBINATION BAND $\nu_4 + \nu_5$ OF ACETYLENE. T.J.Coburn, K.Narahari Rao and H.H.Nielsen.
J. chem. Phys., Vol. 25, No. 3, 607 (Sept., 1956).

The anomalous centrifugal stretching constant of C_2H_2 is studied by measurement of the rotational structure of this band. J.Hawgood

539.132

2473. BINARY COMBINATION BANDS OF THE OUT-OF-PLANE CH VIBRATIONS OF BENZENE DERIVATIVES. Y.Kakiuti.
J. chem. Phys., Vol. 25, No. 4, 777-8 (Oct., 1956).

Frequencies and intensities of these bands have been calculated for eleven alkyl benzenes. Most of the predicted frequencies have been observed and are within 10 cm^{-1} of the predictions. J.Hawgood

539.132

2474. ASSIGNMENT OF THE OH IN-PLANE DEFORMATION FREQUENCY. S.Krimm, C.Y.Liang and G.B.B.M.Sutherland.
J. chem. Phys., Vol. 25, No. 4, 778 (Oct., 1956).

Observations of the infrared spectra of normal and deuterated polyvinyl alcohol are interpreted with a δ(OH) frequency of 1250 cm^{-1} in the monomeric state, which in the associated molecule interacts with a CH bending mode to give mixed vibrations near 1330 and 1410. Other evidence from tertiary and secondary alcohols supports this hypothesis, which replaces the earlier assignment for associated alcohols of δ(OH) as a doublet at 1330 to 1410 (see Abstr. 4551/1956). J.Hawgood

539.132

2475. TUNNELING THROUGH HIGH PERIODIC BARRIERS. I. T.P.Das.
J. chem. Phys., Vol. 25, No. 5, 896-903 (Nov., 1956).

Analytic expressions for tunnelling frequencies through high periodic barriers are derived. The expression for wells of threefold symmetry is applied to the analysis of microwave data on CH_3SiF_3, CH_3SiH_3, and CH_3SiD_3 and values of the barrier heights of 1 kcal, 1.5 kcal and 1.5 kcal per mole, respectively, are obtained, which are in reasonable agreement with previously obtained values. A.

539.132

2476. COUPLED ANHARMONIC VIBRATIONS AS A CAUSE OF BROADENING OF SPECTRAL BANDS: HYDROGEN BONDED SYSTEMS. H.L.Frisch and G.L.Vidale.
J. chem. Phys., Vol. 25, No. 5, 982-6 (Nov., 1956).

The broadening of molecular spectral bands in hydrogen bonded systems is calculated for a simple model of the hydrogen bonded molecule on the assumption that it is due to the precession of coupled anharmonic vibrations. The approximate classical mechanics of such a generalized system is developed in terms of known results in the theory of nonlinear mechanics. It is shown that when reasonable molecular parameters are substituted into the calculated broadening one obtains values consistent in all respects with the experimental data. A.

539.132

2477. NH_2 DEFORMATION FREQUENCIES OF INORGANIC COORDINATION COMPLEXES. S.Mizushima, I.Nakagawa and D.M.Sweeny.
J. chem. Phys., Vol. 25, No. 5, 1006-8 (Nov., 1956).

The normal vibrations of the infinite chain of the $(HgNH_2)^+$ ion has been calculated on the basis of the Urey–Bradley field. The calculated values have been found to be in good agreement with those observed in the infrared spectra of $HgNH_2Cl$. A.

539.132

2478. COMPARISON OF FORCE CONSTANTS IN RADICALS AND MOLECULES. THE HALIDES OF ZINC, CADMIUM, AND MERCURY. W.Klemperer.
J. chem. Phys., Vol. 25, No. 5, 1066-8 (Nov., 1956).

The infrared spectra of the molecules HgI_2, $CdCl_2$, $CdBr_2$, CdI_2, ZnI_2, $ZnBr_2$ and $ZnCl_2$ have been observed in the region of the fundamental frequency of the antisymmetric stretching motion. A comparison is made between the bond stretching force constants of these

molecules together with $HgCl_2$ and $HgBr_2$ and the force constants of the related diatomic monohalides. As a group the dihalides exhibit different trends in their force constants than the monohalides. A.

539.132

2479. THEORY OF ROTATIONAL–VIBRATIONAL INTERACTION IN POLYATOMIC MOLECULES. L.J.Bodi and C.F.Curtiss.
J. chem. Phys., Vol. 25, No. 6, 1117-22 (Dec., 1956).

Group theoretical considerations show that an eigenfunction of the Schrödinger equation for a polyatomic molecule may be written as a sum of products of representation coefficients of the group of three-dimensional rotations and functions which depend only upon the relative configuration of the atoms and hence only upon the normal coordinates. A perturbation solution of the Schrödinger equation is described which is based on zero order wave-functions which are consistent with this group theoretical result. All of the angular momentum operators appearing in the wave equation are shown to be recursion operators in the representation coefficients. Subsequent utilization of the orthogonality of the representation coefficients then leads to a set of coupled differential equations for the functions which depend only on the normal coordinates. This set of coupled differential equations is a generalization of the matrix equations for the rotational motion of a rigid body. The functions of the normal coordinates are then expanded as sums of products of Hermite functions of the individual normal coordinates. Use of the orthogonality relations of the Hermite functions then yields a set of equations for the expansion coefficients. The eigenvalues of the associated matrix are then, of course, the exact rotational–vibrational energy levels of the polyatomic molecule. The energy levels are obtained approximately by a diagonalization in the rotational quantum numbers followed by a perturbation technique in which the coupling between vibrational levels is assumed to be small (except in the case of degeneracy). The lowest approximation to the energy levels contains terms which may be interpreted as due to coupling effects which in previous solutions appear only in higher order approximations. A.

539.132

2480. ABNORMAL ROTATION IN RADIATIVE COLLISION OF ELECTRONS WITH WATER MOLECULES. T.Horie, T.Nagura and M.Otsuka.
Phys. Rev., Vol. 104, No. 2, 547-8 (Oct. 15, 1956).

The intensities of rotational lines emitted along the x-axis from excited OH molecules produced at the intersection of a beam of water molecules (z-axis) and a beam of electrons of uniform velocities (y-axis) are measured, the three axes being mutually perpendicular. Almost all the molecules are found to be rotating abnormally and the rotational intensity distribution is independent of the energy of the colliding electrons. G.Allen

539.132 : 535.343

2481. r- CENTROIDS FOR THE O_2^+ SECOND NEGATIVE, N_2 LYMAN-BIRGE-HOPFIELD, AND N_2 VEGARD-KAPLAN BAND SYSTEMS. R.W.Nicholls, D.Robinson, W.Parkinson and W.R.Jarmain.
Proc. Phys. Soc. A, Vol. 69, Pt 9, 713-15 (Sept., 1956).

Following the definition of the r-centroid previously given (Abstr. 6052/1956), values of r-centroids and wavelengths of band-heads are tabulated and briefly discussed. G.I.W.Llewelyn

539.132 : 535.343

FORCE CONSTANTS OF BORATE ION. See Abstr. 2032

539.132 : 535.375.5

FORCE CONSTANTS OF PI_3 AND AsI_3. See Abstr. 2067

539.132

2482. CALCULATION OF π-ELECTRONIC POLARIZABILITY OF POLYENES AND BENZENE USING A "METALLIC" MOLECULAR MODEL. M.N.Adamov and I.S.Milevskaya.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 1, 57-60 (1956). In Russian.

The results of calculations based on the simplest form of the "metallic" model, which assumes that in the absence of an external field the electrons are free to move along certain lines and that outside these lines their potential energy becomes infinite, are compared with those published by Bolton (Abstr. 3943/1955). It is found that only for the ground and the first two excited states are the calculated polarizabilities positive, and that practically all the polarizability of benzene is determined by π-electrons, instead of only about half (according to Bolton). R.C.Murray

539.132

2483. CALCULATION OF π-ELECTRON DENSITIES IN MOLECULES OF MONOSUBSTITUTED BENZENE ON THE BASIS OF A METALLIC MODEL. A.B.Almazov and D.A.Bochvar.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 1, 121-3 (1956). In Russian.

Calculations of π-electron densities, for chlorobenzene, assuming that the potential energy trough in which the π-electron moves is rectangular, indicate that in the "metallic" model (which assumes the π-electron is able to move freely around the whole perimeter of the ring) of monosubstituted benzenes there is an absolute maximum of π-electron charge density in the p-position to the substituent. This maximum is not likely to be eliminated by any change of the parameters of the potential trough through change of substituent. Relative maxima can be produced in other positions in the ring, e.g. close to both o- or m-positions, and it is quite possible that the sum of the maxima for the o- or m-positions may be larger than the p-maximum. R.C.Murray

539.132

2484. SUBSTITUTED METHANES. XXVII. POTENTIAL CONSTANTS AND CALCULATED THERMODYNAMIC PROPERTIES FOR CH_2F_2, $CHDF_2$, AND CD_2F_2. A.G.Meister, J.M.Dowling and A.J.Bielecki.
J. chem. Phys., Vol. 25, No. 5, 941-2 (Nov., 1956).

For Pt XXVI see Abstr. 6015 (1955). Using the Wilson FG matrix method, potential constants were determined for the CH_2F_2 molecule using the most general quadratic potential function. The same constants were used to calculate the wave numbers of the fundamentals of the $CHDF_2$ and CD_2F_2 molecules. Finally, the heat content, free energy, entropy and heat capacity were calculated for all three molecules for 12 temperatures from 100^0 to 1000^0K, for the ideal gaseous state at 1 atm pressure. A.

539.132 : 535.343

2485. THE INTERPRETATION OF INTENSITY DISTRIBUTIONS IN THE CN VIOLET, C_2 SWAN, OH VIOLET AND O_2 SCHUMANN–RUNGE BAND SYSTEMS BY USE OF THEIR r-CENTROIDS AND FRANCK–CONDON FACTORS. R.W.Nicholls.
Proc. Phys. Soc. A, Vol. 69, Pt 10, 741-53 (Oct., 1956).

Intensity distributions in the CN violet, C_2 Swan, OH violet and O_2 Schumann–Runge band systems are examined to determine in each case the dependence of the electronic transition moment $R_e(r)$ upon internuclear separation r, with the aid of Franck–Condon factors $q_{v'v''}$ and r-centroids $\bar{r}_{v'v''}$. It is found that $R_e(r) = \text{const}(-1 + 2.579r)$ for the CN violet system, that $R_e(r) = \text{constant}(1 + 0.056r)$ for the C_2 Swan system, that $R_e(r) = \text{const}(1 - 0.756r)$ for the OH violet system and that $R_e(r) = \text{const}(-1 + 2.416r - 0.897r^2)$ for the O_2 Schumann–Runge system. "Smoothed" arrays of relative vibrational transition probabilities have thereby been determined for each band system. A.

539.132 : 539.152.2

2486. PARAMAGNETIC RESONANCE ABSORPTION IN $^{235}UCl_3$, AND THE NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF ^{235}U. B.Bleaney, C.A.Hutchison,Jr, P.M.Llewellyn and D.F.D.Pope.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1167-9 (Nov., 1956).

The electron resonance spectrum of $LaCl_3$ + 0.1% of UCl_3 enriched with U^{235} is observed at 3.2 and 1.3 cm and transitions with $\Delta m = \pm 2$ and ± 1 as well as $\Delta m = 0$ are observed. The Hamiltonian includes the terms $B(S_xI_x + S_yI_y)$ and $P\{I_z^2 - I(I+1)/3\}$ with $|B| = 58.2 \times 10^{-4}$ and $|P| = 5.5 \times 10^{-4}$ cm^{-1}. The nuclear quadrupole moment is given by $|Q| = 3.8 \times 10^{-24}$ approximately. D.H.Whiffen

539.132

2487. PARAMAGNETIC RESONANCE ABSORPTION IN SOME ORGANIC BIRADICALS. H.S.Jarrett and G.J.Sloan.
J. chem. Phys., Vol. 25, No. 4, 697-701 (Oct., 1956).

Four compounds of the form 4,4'-polymethylenebistriphenylmethyl, one compound of the form (1,4-phenylene)bisdiarylmethyl, three compounds of the form (4,4'-biphenylene)bisdiarylmethyl, and one compound, 4,4'-oxybistriphenylmethyl have been shown to possess unpaired electrons by paramagnetic resonance absorption. The resonance spectra of 0.01 M solutions of these compounds in benzene exhibit a hyperfine structure arising from a spherically symmetrical contribution of the magnetic dipole interaction between the unpaired electron and the nuclear magnetic moments of the hydrogen atoms. The g-factors for the compounds investigated in the first three classes were found to be 2.0025 ± 0.0004 and 2.0031 ± 0.0004 for the last compound. Such a close approach of the g-factor to the free electron value plus the sharpness of the hyperfine structure lines indicates that the anisotropic contributions of the spin-orbit interaction, which would normally lift the degenracy of the triplet state, are averaged out by the tumbling of the molecules. A.

539.132

2488. PARAMAGNETIC RESONANCE SPECTRUM OF AMMONIUM CHROMIUM ALUM. C.F.Davis,Jr and M.W.P.Strandberg.
Phys. Rev., Vol. 105, No. 2, 447-55 (Jan. 15, 1957).

A detailed solution of the fine-structure splitting of the ground state of the chromium ion is given. This solution assumes an electric field of cubic symmetry with a small trigonal distortion and the residual spin–orbit coupling superposed. The effect of a magnetic field at an arbitrary orientation is calculated. Absorption positions and relative intensities are calculated and checked with experiment. Lines of character predominantly $\Delta S_Z = 2,3$ are shown to have sufficient $\Delta S_Z = 1$ character to give the experimentally determined intensities. So-called "forbidden transitions" are accounted for quantitatively by this detailed calculation. Shapes of absorption peaks are Lorentzian for dilute specimens and Gaussian for full-strength alum. A small variation of trigonal Stark field from one paramagnetic ion to another is sufficient to account for the observed line width. A.

539.132

2489. PARAMAGNETIC RESONANCE OF URANIUM IONS. B.Bleaney, P.M.Llewellyn and D.A.Jones.
Proc. Phys. Soc. B, Vol. 69, Pt 8, 858-60 (Aug., 1956).

Paramagnetic resonance spectra are observed for U^{+++} and Nd^{+++} in CaF_2 and SrF_2 lattices. The ground state of the ions is $^4I_{9/2}$ and a local tetragonal field splits this into doublets and the lowest is an admixture of states with $J_Z = \pm 9/2, \pm 1/2$ and $\mp 7/2$. The extra F^- ion to balance the trivalent cation occupies an interstitial site adjacent to the cation. In the U^{+++} coupling to the F^- nuclei is observed. D.H.Whiffen

539.132

2490. PARAMAGNETIC RESONANCE IN SOME COMPLEX CYANIDES OF THE IRON GROUP. I. EXPERIMENTAL RESULTS. J.M.Baker, B.Bleaney and K.D.Bowers.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1205-15 (Dec., 1956).

The results are described of paramagnetic resonance experiments on some complex cyanides of the iron group. The form of the spin Hamiltonian is found and the values of the parameters are measured. Potassium chromicyanide and potassium vanadocyanide (configuration $3d^3$), diluted with the isomorphous diamagnetic salts, have effective spin 3/2 with an electronic splitting of rhombic symmetry. The g-value is closely isotropic at 1.992, and the hyperfine structure is also isotropic. Potassium ferricyanide and potassium manganicyanide (configuration $3d^5$), diluted with the isomorphous diamagnetic salt, have effective spin ½ with anisotropic g-values between 0.6 and 2.6. The manganicyanide also exhibits an anisotropic hyperfine structure. The behaviour of undiluted potassium chromicyanide and potassium ferricyanide suggests that there is appreciable exchange interaction between neighbouring paramagnetic complexes. A.

539.132

2491. PARAMAGNETIC RESONANCE IN SOME COMPLEX CYANIDES OF THE IRON GROUP. II. THEORY. B. Bleaney and M.C.M.O'Brien.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1216-30 (Dec., 1956).

The theory of Stevens for covalent XY_6 complexes is developed for the cases of d^3 and d^5 with low symmetry, and compared with the magnetic resonance results of the preceding paper. The effect of the coupling to the doublet states on the spin Hamiltonian constants for the d^3 complexes is found to be small compared with that of coupling to the quartet states, although the latter are probably further removed energetically. In the d^5 complexes it is shown that the relation between the g-values and the susceptibility does not depend on the orientation of the principal axes of the g-tensor relative to the complex; the principal values of the susceptibility of $K_3Fe(CN)_6$ are calculated from the g-values and compared with earlier experimental determinations, the value of the spin–orbit coupling being adjusted to give the best fit. The observed hyperfine constants for $K_4Mn(CN)_6 3H_2O$ are compared with the theoretical expressions and can be explained with reasonable values of the parameters. The orbital g-factor k is found to be 0.87 for the ferricyanide and 0.74 for the manganocyanide. An appendix discusses the conditions under which hyperfine terms of low symmetry can appear in the spin Hamiltonian, and the effect they may have on the observed spectrum. A.

539.132

2492. HYPERFINE STRUCTURE IN THE PARAMAGNETIC RESONANCE SPECTRUM OF $(Cr^{53})^{+++}$ IN Al_2O_3. A.A.Manenkov and A.M.Prokhorov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 346-7 (1956). In Russian.

A single crystal of Al_2O_3 with added $(Cr^{53})^{+++}$ showed the $M_{1/2} \leftrightarrow -_{1/2}$ paramagnetic resonance transition with four hyperfine structure lines. The Hamiltonian coefficients are given by $|B| \sim |A| = (17.0 \pm 0.5) \times 10^{-4}$ cm^{-1}. D.H.Whiffen

539.132 : 539.133

2493. DIMERIZATION OF SOLID GROUP IIIB TRIHALIDES. II. IODINE NUCLEAR QUADRUPOLE RESONANCE SPECTRA OF AlI_3, GaI_3, AND InI_3. S.L.Segel and R.G.Barnes.
J. chem. Phys., Vol. 25, No. 3, 578-9 (Sept., 1956).

For Pt I, see Abstr. 8901 (1956). I quadrupole transition frequencies and their temperature coefficients are given for AlI_3, GaI_3 and InI_3. These indicate that there are I atoms in the dimer bridges and that these I have low quadrupole couplings with high asymmetry parameters compared with the external I. D.H.Whiffen

539.132

2494. NUCLEAR MAGNETIC RESONANCE ABSORPTION BY H_2O AND TiO_2. J.M.Mays and G.W.Brady.
J. chem. Phys., Vol. 25, No. 3, 583 (Sept., 1956).

N.m.r. is observed for protons of H_2O at 0.04, 0.07 and 1 monolayer adsorbed on TiO_2. Even at 77°K there is motion of the H_2O with a correlation time about 3×10^{-7} sec at low coverages, whereas the full monolayer gave a broad, ice-like, line at 77°K. D.H.Whiffen

539.132

2495. MEASUREMENT OF SMALL NUCLEAR SPIN–SPIN COUPLING CONSTANTS. C.A.Reilly.
J. chem. Phys., Vol. 25, No. 3, 604-5 (Sept., 1956).

Rapid passage transition ringing patterns are used in nuclear magnetic resonance to measure small spin–spin couplings, e.g. $J = 1.48$ c/s for dissimilar F in CF_3CF_2COOH. D.H.Whiffen

539.132

2496. ELECTRON SPIN RESONANCE IN FREE RADICALS DERIVED FROM DIARYLAMINES. R.Hoskins.
J. chem. Phys., Vol. 25, No. 4, 788 (Oct., 1956).

The electron spin resonance spectra showing hyperfine structure are given for solutions of the free radicals produced by oxidation of diphenylamine and N-phenyl-2-naphthlyamine. D.H.Whiffen

539.132

2497. HYDROGEN BONDING BY N.M.R. A.D.Cohen and C.Reid.
J. chem. Phys., Vol. 25, No. 4, 790-1 (Oct., 1956).

With dilution,the n.m.r. proton resonance of the OH group of alcohols shifts up to 170 c/s in 40 Mc/s as the proportion of monomer is increased. The hydrogen bonded polymer is predominantly trimeric. The proton signal from an aldehyde group is concentration independent indicating polymerization not to occur through hydrogen bonding. D.H.Whiffen

539.132 : 548.7

2498. As^{75} PURE QUADRUPOLE RESONANCE IN SYNTHETIC CLAUDETITE. P.J.Bray, G.O'Keefe and R.G.Barnes.
J. chem. Phys., Vol. 25, No. 4, 792-3 (Oct., 1956).

The As quadrupole resonances near 110 Mc/s in synthetic claudetite, a chain crystal of As_2O_3,indicate the s-p hybridization to be very close to that in arsenolite with As_4O_6 units. D.H.Whiffen

539.132

2499. FIELD-DEPENDENT PROTON RELAXATION TIMES IN SOLUTIONS OF Mn^{++}. A.L.Bloom.
J. chem. Phys., Vol. 25, No. 4, 793-4 (Oct., 1956).

In solutions of Mn^{++} the proton relaxation time, T_2, for spin–spin interactions is field and frequency independent from 2200 c/s upwards, but the spin–lattice time, T_1, increases with resonance frequency, ν_0, in accordance with $T_2/T_1 = \alpha + (1-\alpha)/[1+(2\pi\nu_0\tau)^2]$ where $\alpha = 0.33$ and τ is the correlation time and is 2.1×10^{-8} sec with ν_0 below 10^7 c/s. This is thought to be the lifetime of a H_2O molecule in the first hydration sheath. D.H.Whiffen

539.132

2500. ELECTRON SPIN RESONANCE ABSORPTION OF PERYLENE IN SULFURIC ACID SOLUTION. Y.Yokozawa and I.Miyashita.
J. chem. Phys., Vol. 25, No. 4, 796-7 (Oct., 1956).

Perylene in sulphuric acid shows electron spin resonance absorption; the variation of intensity with temperature suggests that it is due partly to a triplet level 1.7 kcal above the ground state and partly to a free radical. The latter can be detected in the solid thrown out of solution by iced water. D.H.Whiffen

539.132

2501. NITRYL FLUORIDE: A NEW METHOD OF PREPARATION, NUCLEAR MAGNETIC SPECTRUM AND STRUCTURE. R.A.Ogg Jr and J.D.Ray.

J. chem. Phys., Vol. 25, No. 4, 797-8 (Oct., 1956).

The n.m.r. spectrum of F in FNO_2 shows a hyperfine structure of three lines with 225 c/s overall separation which indicates a direct N–F link. D.H.Whiffen

539.132

2502. PURE QUADRUPOLE RESONANCES IN MULTICHLOROBENZENES. P.J.Bray, R.G.Barnes and R.Bersohn.
J. chem. Phys., Vol. 25, No. 5, 813-18 (Nov., 1956).

The location and measurement of the nuclear quadrupole resonances of Cl^{35} in all multichlorobenzenes has been completed with the detection of resonance frequencies in five such compounds. A summary of the data on all the multichlorobenzenes is presented, including these reported for the first time: 1,2,3-trichlorobenzene; 1,3,5-trichlorobenzene; 1,2,3,4-tetrachlorobenzene; 1,2,3,5-tetrachlorobenzene; and pentachlorobenzene. These data indicate that the chlorine resonance frequency acquires frequency increments approximately proportional to the number of ortho chlorine neighbours. This effect may be interpreted primarily in terms of electron induction away from the resonant chlorine, although out of plane bending and double bond character also affect the resonance frequency. A correlation of the chlorine quadrupole frequencies with the Hammett sigma parameter is also given. A.

539.132

2503. FLUORINE MAGNETIC RESONANCE SPECTRA OF SOME MONO- AND DISUBSTITUTED TETRAFLUOROCYCLOBUTANES. W.D.Phillips.
J. chem. Phys., Vol. 25, No. 5, 949-55 (Nov., 1956).

The fluorine magnetic resonance spectra of a series of tetrafluorocyclobutane molecules substituted unsymmetrically with respect to the plane of the cyclobutane ring are reported. The complex spectra of these compounds are interpreted in terms of nonequivalence of fluorine atoms bonded to a common ring carbon atom. Nonequivalence of fluorine atoms bonded to a common carbon atom is discussed in terms of restricted rotation about C–C bonds in cyclic structures and possible intramolecular interaction mechanisms for producing the nonequivalence. A.

539.132

2504. ISOTOPE EFFECT IN NUCLEAR QUADRUPOLE SPECTROSCOPY. J.Duchesne, A.Monfils and J.Garsou.
Physica, Vol. 22, No. 9, 816-17 (Sept., 1956). In French.

The Br and I quadrupole resonances in solid CH_3Br, CH_3I, CD_3Br and CD_3I are observed between 200 and 300 Mc/s. The fractional change to lower coupling on deuteration, $\Delta eQq/eQq = 1.82 - 2.03 \times 10^{-3}$ and is slightly temperature dependent; these values are smaller than the shifts in the gas phase measured by microwaves. D.H.Whiffen

539.132

2505. MODIFIED ATOMIC ORBITAL METHOD. II. THE ELECTRONIC STRUCTURE OF THE OXYGEN MOLECULE. T.Itoh and K.Ohno.
J. chem. Phys., Vol. 25, No. 6, 1098-101 (Dec., 1956).

For Pt I, see Abstr. 8973 (1955). The modified form of the nonempirical atomic orbital method is applied to the computation of the lower excited π-electron levels of the oxygen molecule. The results of the calculation are again satisfactory in that they are almost as good as those obtained by the semiempirical methods of Moffitt and of Fumi and Parr. A.

539.132

2506. ELECTRONIC SPECTRUM AND STRUCTURE OF AZULENE. R.Pariser.
J. chem. Phys., Vol. 25, No. 6, 1112-16 (Dec., 1956).

A previously given theoretical method is applied to the azulene molecule π electron energies, transition moments, dipole moments, charge distributions, and bond orders are calculated for the ground state and for the lower singlet and triplet excited states. The same detailed procedure which had previously given good results for the polyacenes is used here. Configuration interaction is included for all singly excited configurations. Two parallel calculations, one starting with conventional Hückel MOs and the other with perimeter MOs, are carried through. Hückel MOs lead to numerical results in good agreement with available experimental spectral data. In this connection some previous assignments are confirmed and some new ones are proposed. For the π electron dipole moment for the ground state, one calculates 1.88 D with Hückel MOs and 3.36 D with perimeter MOs; the experimental value is 1 D. One may conclude that the present procedure gives results in substantial agreement with experiment provided that good MOs, e.g. Hückel MOs, are employed. For computation of excited state energies it is essential to include interaction among nearly degenerate configurations. More extensive configuration interaction, however, appears to improve the transition energies and especially the transition moments and dipole moments. A.

539.132

2507. RESONANCE FORCES AT LARGE SEPARATIONS. A.Dalgarno and N.Lynn.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 821-9 (Nov., 1956).

A simple perturbation method is suggested for the calculation of energies of the states of homonuclear molecules at large internuclear distances R for which the identity of the nuclear fields must be taken into account, a comparison with exact data on the $1s\sigma_g$ and $2p\sigma_u$ states of H_2^+ showing that results of high accuracy can be obtained without undue labour. The method is also applied to the $^1\Sigma_g$ and $^3\Sigma_u$ states of H_2 and reasons are advanced for supposing that the results are, at least for R greater than $4a_0$, more accurate than those of any previous calculation. A.

539.132

2508. A THEORETICAL STUDY OF PENTAVALENT PHOSPHORUS. C.Carter.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1297-300 (Dec., 1956).

Molecular orbital calculations have been made for the molecule PH_5 assuming a bipyramidal model. The calculations confirm the conclusion of Craig, Maccoll, Nyholm, Orgel and Sutton that a free atom 3d atomic orbital of phosphorus is much too diffuse to give a good description of molecular binding. The reasons for this are discussed. A.

539.133 : 535.343

STRUCTURE OF THE THIOCYANATE ION. See Abstr. 2029

539.133

2509. DIPOLE MOMENT OF NF_3. P.Kisliuk.
J. chem. Phys., Vol. 25, No. 4, 779 (Oct., 1956).

Criticism of calculation by Mashima (Abstr. 3904/1956) which assumes directed single s–p bonds, on the grounds that ionic terms are neglected, that multiple bonding is needed to explain the nuclear quadrupole coupling, and that Mashima's 53% s character is much more than that needed for maximum overlap. J.Hawgood

539.133

2510. DIPOLE MOMENT OF NF_3. M.Mashima.
J. chem. Phys., Vol. 25, No. 4, 779 (Oct., 1956).

Reply to criticism by Kisliuk (preceding abstract), denying that the principle of maximum overlap is not satisfied, as it would predict 53% s character, as required by the dipole moment. PCl_3 can be studied by the same method, but for PF_3, ionic terms are needed. J.Hawgood

539.133

2511. ELECTRIC DIPOLE MOMENTS OF THE LOWER VIBRATIONAL STATES OF MOLECULAR CsF AND CsCl. J.Trischka.
J. chem. Phys., Vol. 25, No. 4, 784-5 (Oct., 1956).

Electric resonance measurements of the Stark effect in CsF and CsCl enable equations to be evolved for the dipole moments of these molecules. G.I.W.Llewelyn

539.133

2512. CHARGE DISTRIBUTION IN THE HYDROGEN MOLECULE. M.Karplus.
J. chem. Phys., Vol. 25, No. 3, 605-6 (Sept., 1956).

Comparison of experimental and theoretical values for the second moments and quadrupole moment of the electronic charge distribution in H_2, the theoretical values being calculated from the Heitler–London, Wang and Coulson LCAO-MO wave-functions. The effective charge used in the latter two functions brings the second moments (the "size") but not the quadrupole moment ("shape") into reasonable agreement with experiment. J.Hawgood

539.133

2513. TIN–HYDROGEN BOND DISTANCE. G.R.Wilkinson and M.K.Wilson.
J. chem. Phys., Vol. 25, No. 4, 784 (Oct., 1956).

Infrared spectral measurements have been made on a sample of SnD_4 containing a small percentage of $SnHD_3$. Analysis of the Sn–H stretching vibration (ν_3) of $SnHD_3$ gives a value of 1.701 ± 0.001 A for the Sn–H bond length. G.I.W.Llewelyn

539.133 : 535.343

2514. INFRARED SPECTRA AND MOLECULAR STRUCTURES OF SiH_3F, SiH_3Cl, AND SiH_3Br. C.Newman, J.K.O'Loane, S.R.Polo and M.K.Wilson.
J. chem. Phys., Vol. 25, No. 5, 855-9 (Nov., 1956).

The structure of the e-type fundamentals has been resolved and

analysed. The values of the small amount of inertia thus obtained has been combined with microwave measurements to yield the dimensions of the SiH_3 group in these molecules. It is shown that the differences in the structure of the SiH_3 group are probably within experimental error. Several revisions have been made in the vibrational assignments for SiH_3F and SiH_3Cl. A.

539.133 : 535.343

STRUCTURE OF PERCHLORYLFLUORIDE. See Abstr. 2043

539.133 : 535.343

2515. VIBRATIONAL INTENSITIES IN HALOGENATED METHANES. II. METHYLENE BROMIDE AND METHYLENE IODIDE. N.L.Singh and J.W.Straley.
J. chem. Phys., Vol. 25, No. 3, 490-4 (Sept., 1956).

For Pt I, see Abstr. 1456 (1956). The absolute intensities of the fundamental bands in CH_2Br_2 and CH_2I_2 of species B_1 and B_2 have been measured. The intensities observed are, in cycles/sec at N.T.P.

	CH_2Br_2	CH_2I_2
A_6	14.6×10^{10}	37.2×10^{10}
A_7	48.2×10^{10}	77.9×10^{10}
A_8	1003×10^{10}	473×10^{10}
A_9	616×10^{10}	1109×10^{10}

The bond moments and bond derivatives calculated from this data are

	CH_2Br_2	CH_2I_2
μ_{CH}	$+0.55 \times 10^{-18}$	$+0.5 \times 10^{-18}$ (B_1 vibrations) $+0.86 \times 10^{-18}$ (B_2 vibrations)
μ_{CI}	-0.70×10^{-18}	0 (assumed)
$\partial\mu_{CH}/\partial r_{CH}$	$+0.17 \times 10^{-10}$ or -0.10×10^{-10}	$+0.2 \times 10^{-10}$ or -0.10×10^{-10}
$\partial\mu_{CX}/\partial r_{CX}$	$+3.27 \times 10^{-10}$	$+2.1 \times 10^{-10}$

where the ambiguity in signs that led to alternate values of $\partial\mu_{CH}/\partial r_{CH}$ could not be resolved. A.

539.133

2516. DEUTERATION OF AZULENE AND THE STRUCTURE OF THE AZULINIUM ION. H.M.Frey.
J. chem. Phys., Vol. 25, No. 3, 600-1 (Sept., 1956).

The nuclear magnetic resonance spectrum of azulene in conc. H_2SO_4 and D_2SO_4 indicates that two H atoms exchange rapidly, that is in less than 2 min. D.H.Whiffen

539.133

2517. STRUCTURES OF TOLUENE, PHENYLSILANE, AND DIPHENYLDICHLOROSILANE. F.A.Keidel and S.H.Bauer.
J. chem. Phys., Vol. 25, No. 6, 1218-27 (Dec., 1956).

Electron diffraction data taken with a "sector" apparatus are presented. Procedures for the reduction of such data are discussed. Theoretical backgrounds (the sum of atomic coherent plus incoherent scattering) based on Pauling–Sherman and on Hartree atom form factors are compared with the curves observed. Structural information was derived from the resolution of radial distribution curves, and the final molecular models were checked by comparing theoretical molecular scattering curves with the reduced microphotometer traces. A.

539.133 : 535.343

STRUCTURE OF THE THIOPHENE MOLECULE. See Abstr. 2048

539.133

2518. DIMENSIONS OF MOLECULES. A.E.Lutskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 513-16 (1954). In Russian.

A modified equation is proposed for the calculation of atomic volumes in molecules, which uses the covalent atomic radii and the "minimum atomic radius" which is the distance from the nucleus, at which the potential energy of interaction of atoms of different molecules, having comparatively weak van der Waals forces, is a minimum. The atomic volumes calculated using the new equation are listed for various commonly occurring atoms (including O=, S=, etc.). Its use is justified by the good agreement between values of the density at the absolute zero of various halogenated methanes, found by extrapolation from measured values, and those calculated from the molecular volumes obtained by summing the atomic volumes calculated from the new equation. The equation used is $d_0 = M\gamma/Nv_m$, where M = the molecular weight, γ = the packing fraction, assumed to be 0.74 in all cases, N = Avodgadro's number, and v_m = the molecular volume. R.C.Murray

ATOMS. NUCLEUS. ISOTOPES 539.15

539.152.1

2519. THE COLLECTIVE MODEL AND THE PROPERTIES OF THE LOW EXCITED LEVELS OF NUCLEI. L.A.Sliv and L.K.Peker.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 849-52 (1954). In Russian.

It is shown that levels of odd-A nuclei, which do not conform to a single-particle model, have an explanation as rotational states in the collective model. The dependence of their energy on nucleon numbers follows that of the rotational levels of even nuclei. The depression of low single particle levels with increasing deformation is briefly discussed, together with reduction of l-s coupling in excited single-particle states. W.O.Lock

539.152.1

2520. ROTATIONAL STATES OF SPHEROIDAL NUCLEI. F.Coester.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1307-15 (Dec., 1956).

A new method of introducing collective coordinates as dynamical variables is proposed. A Hamiltonian for rotating spheroidal nuclei is constructed by this method. The resulting moments of inertia are discussed. They depend on a parameter ξ which is determined if the intrinsic particle wave-function of the nucleus is known. If ξ is treated as an empirical parameter the observed moments of inertia can be fitted. In order to illustrate the theoretical determination of ξ, calculations have been carried out for independent particles in a harmonic oscillator well without spin–orbit coupling. A.

539.152.1

2521. NUCLEON ENERGY LEVELS IN A VELOCITY-DEPENDENT POTENTIAL. A.A.Ross, R.D.Lawson and H.Mark.
Phys. Rev., Vol. 104, No. 2, 401-10 (Oct. 15, 1956).

The neutron and proton level sequences in a diffuse, velocity-dependent potential have been investigated. A velocity-dependent interaction is used which manifests itself by attributing to a nucleon inside nuclear matter an "effective mass" which is a function of its position. The effective mass in the centre of the nucleus is chosen to be one half the free-particle mass. The potential form was taken as $V(r) = -V_0/\{1 + \exp[\alpha(r-a)]\}$, and for protons a Coulomb potential derived from a uniform charge distribution extending to r = a was added. The proper neutron shell structure and level sequence was obtained with the parameters $\alpha = 1.16 \times 10^{13}\,cm^{-1}$, $a = 1.3A^{1/3} \times 10^{-13}$ cm, $V_0 = 69$ MeV, and a spin–orbit coupling 33 times the Thomas term. For protons, using the same α, radius, and spin–orbit coupling, it was found that the potential depth had to be increased by roughly 13 MeV to bind the correct number of protons in Pb^{208}. If Pauli principle correlations are included, then a deeper proton potential is obtained. This correction depends critically on the form of the nucleon densities. Since a self-consistent treatment has not been made, this effect has been estimated in two ways: (1) A Fermi–Thomas approximation was used to compute the densities. In this case, the correct neutron–proton ratio is obtained but the correct proton level sequence is destroyed. (2) The neutron well depth was increased by an amount $(N + \frac{1}{2}Z)/(Z + \frac{1}{2}N)$. In this approximation the correct level sequence is obtained but it is not possible to bind the proper number of protons. A.

539.152.1

2522. SPIN–ORBIT INTERACTION IN NUCLEI. L.S.Kisslinger.
Phys. Rev., Vol. 104, No. 4, 1077-85 (Nov. 15, 1956).

The L–S interaction in nuclei is derived in terms of the two-body interaction between nuclear particles. A second-order Born approximation with the tensor force gives an interaction of the right order of magnitude, but apparently somewhat too small. A more general approach using the two-body reaction matrix seems to predict the Ca^{41} and O^{17} level splittings. The Thomas interaction is seen to be small. The mixed density function for the nucleus is computed to evaluate the matrix elements. A.

539.152.1

2523. THE NUCLEAR SPIN–ORBIT COUPLING. J.S.Bell and T.H.R.Skyrme.
Phil. Mag. (Eighth Ser.), Vol. 1, 1055-68 (Nov., 1956).

Analysis of the nucleon–nucleon scattering around 100 MeV has determined the spin–orbit coupling part of the two-body scattering matrix at that energy, and a reasonable extrapolation to lower energies is possible. This scattering amplitude has been used, in the spirit of Brueckner's nuclear model, to estimate the resultant single-body spin–orbit coupling for a single nucleon interacting with a large nucleus. This resultant potential has a radial dependence

approximately proportional to $r^{-1}d\rho/dr$, and with a magnitude in good agreement with that required to explain the doublet splittings in nuclei and the polarization of nucleus scattered elastically off nuclei. A.

539.152.1 : 537.533.74

2524. ELECTRON SCATTERING AND NUCLEAR STRUCTURE. R.Hofstadter.
Rev. mod. Phys., Vol. 28, No. 3, 214-54 (July, 1956).

The influence of finite nuclear size on scattering formulae is described, and form-factors for the various models are derived. Phase-shift analysis for the heavy elements is discussed. The various scattering phenomena are explained, including nuclear excitation, electrodisintegration, the real and virtual radiative processes, magnetic scattering and effects due to "rotational levels". The spectrometer installations at the 190 MeV and 550 MeV points on the Stanford electron linear accelerator are described in detail, and a detailed review of the experimental work carried out at Stanford is given, in order of increasing target atomic number, viz. H, D, α, Li, Be, C, Mg, Si, S, A, Sr, heavier nuclei, and the neutron. The results include data on angular distribution, observed form-factors, cross-sections etc. Comparisons are made with theory and conclusions drawn regarding the validity of the various models. For example, the data for protons indicate that the Gaussian, exponential and hollow-exponential models provide an equally good fit with experiment, giving a mean proton radius for best fit of 0.77 ± 0.10 Fermi units. The Yukawa model does not satisfy the proton data. Finally, the validity of electrodynamics is discussed, and other methods of investigating nuclear structure are compared. It is concluded that the electron scattering method is promising, but still in an early stage of development. Future improvements are suggested. N.M.King

539.152.1

2525. THE NUCLEAR RADIUS AND POTENTIAL FROM NEUTRON DIFFRACTION SCATTERING. R.Wilson.
Phil. Mag. (Eighth Ser.), Vol. 1, 1013-26 (Nov., 1956).

Neutron diffraction scattering at high energies is discussed and it is shown that two parameters can be derived from the data; the nuclear radius and the nuclear potential, both with little effect of other parameters. These parameters are derived for each nucleus individually. The radius, so derived, is larger than the charge distribution radius. The potential agrees with that derived from the analysis of total cross-sections of all elements simultaneously when a nuclear potential with a reasonable taper is assumed. A.

539.152.1

2526. NEUTRON AND PROTON DISTRIBUTIONS IN Pb. A.Abashian, R.Cool and J.W.Cronin.
Phys. Rev., Vol. 104, No. 3, 855-6 (Nov. 1, 1956).

Absorption cross-sections for π^-- and π^+-mesons in Pb can be related by the optical model to the radii of neutron and proton densities. The experimental results indicate that the neutron density does not have a larger radius than the proton density. G.E.Brown

539.152.1

2527. SPATIAL DISTRIBUTION OF THE CHARGE AND THE "ELECTRICAL RADIUS" OF HEAVY NUCLEI. G.F.Drukarev.
Uspekhi fiz. Nauk, Vol. 60, No. 3, 391-412 (1956). In Russian.

Information on the spatial distribution of the charge of a nucleus is obtained from phenomena in which the electromagnetic interaction of particles is involved. The paper discusses: theory of electron scattering by the nucleus, experimental work on the scattering of fast electrons and its theoretical interpretation, the Coulomb energy of heavy nuclei, X-ray spectra of μ-mesic atoms. C.R.S.Manders

539.152.1

2528. COULOMB EXCITATION OF MEDIUM-WEIGHT NUCLEI. G.M.Temmer and N.P.Heydenburg.
Phys. Rev., Vol. 104, No. 4, 967-80 (Nov. 15, 1956).

Gamma-ray transitions in nuclei from titanium to caesium which are Coulomb-excited by alpha-particles of energy up to 7 MeV have been studied. Energies and reduced transition probabilities have been obtained for most 2^+ first excited states of the even-even nuclei, using isotopically enriched targets. A number of these states had not been observed previously. Agreement is obtained with the lifetime values from resonance fluorescence in the two cases where such a comparison is possible at present (Ge^{72} and Ge^{74}). All even-even transitions are found to be systematically faster than the single-proton estimate by a factor ranging from 10 to 50, being always slowest near closed shells. Their interpretation as vibrational excitations of nuclei with spherical equilibrium shapes leads to values for the inertial parameters B_2 and surface tensions C_2 (in the vibrational Hamiltonian) showing strong shell structure effects. A number of thick-target excitation functions between 3 and 7 MeV are in excellent accord with semiclassical E2 theory. No obvious systematic behaviour is encountered in the odd-A nuclei, although most transitions contain considerably enhanced E2 components. Coincidence and angular distribution measurements were performed for Se^{77} and Ru^{101} to establish decay schemes and spins of excited states. The 17.5 sec E3 isomer in Se^{77} was excited indirectly via a higher state. No rotational spectra were encountered, with the possible exception of Se^{77}. A.

539.152.1

2529. COULOMB EXCITATION AND CASCADE DECAY OF ROTATIONAL STATES IN ODD-MASS NUCLEI. N.P.Heydenburg and G.M.Temmer.
Phys. Rev., Vol. 104, No. 4, 981-9 (Nov. 15, 1956).

Gamma radiation was observed from the first two excited states, as well as the cascade transition between them, by bombarding the following odd-mass rare-earth nuclei with 6 MeV alpha particles: Eu^{151}, Eu^{153}, Gd^{155}, Gd^{157}, Tb^{159}, Ho^{165}, Lu^{175}, Hf^{177}, Hf^{179} and Ta^{181}. All of these nuclei were available as enriched targets. X-X, X-γ, and γ-γ coincidences from these nuclei were also detected, establishing their previously suggested level schemes. All of them show rotational spectra except Eu^{151} (N = 88), which was found to have an excitation spectrum very different from that of Eu^{153} (N = 90) in both the intensity and position of the excited states. From the measured branching ratios of the second rotational states the M1 – E2 mixture ratios were determined for the cascade radiation, using the theoretical value for the E2 component. This is reasonable because within the experimental uncertainties, mainly caused by lack of information on total internal conversion coefficients, the ratios of E2 transition probabilities from ground state to the two rotational states are in agreement with the theory. Combining the mixture ratio with the values of the ground state magnetic moments, the so-called intrinsic and collective g factors were computed from the strong-coupling approximation of the Bohr–Mottelson theory. Two pairs of values are obtained because of the ambiguity in the phase of the mixture ratio. Appreciable deviations from the irrotational value Z/A are observed for the collective g factors. The mixtures determined also agree with those known from radioactive decay for first-excited state transitions as predicted by the unified model. A.

539.152.1

2530. CONTRIBUTION OF COULOMB EXCITATION TO INELASTIC SCATTERING BETWEEN NUCLEAR RESONANCES. G.M.Temmer and N.P.Heydenburg.
Phys. Rev., Vol. 104, No. 4, 989-92 (Nov. 15, 1956).

Using the comparison method of Bjerregaard and Huus, the relative gamma-ray yields have been determined for thin targets (~ 10 keV) of F^{19} (198 keV state) and Na^{23} (446 keV state), with protons and alpha-particles over energy intervals corresponding to the same values of ξ, the adiabatic parameter in Coulomb excitation. Between the proton resonances it was found that the yield ratios agreed closely with those predicted for E2 Coulomb excitation, and differed by about 50% from E1 (or E3) excitation. Thus the nonresonant inelastic scattering yield between proton resonances in these light nuclei can be entirely accounted for by Coulomb excitation of the E2 type. A slight, negative anisotropy was found in the angular distribution of the 446 keV gamma-ray following Coulomb excitation of Na^{23}, fixing the spin of that state of $5/2^+$. A.

539.152.1

2531. COULOMB EXCITATION OF V, Ni, Ga, AND Rb. L.W.Fagg, E.H.Geer and E.A.Wolicki.
Phys. Rev., Vol. 104, No. 4, 1073-6 (Nov. 15, 1956).

The Coulomb excitation of several odd-Z or odd-N medium-weight nuclei has made possible the observation of the following gamma-rays: V^{50}, 226 keV; Ni^{61}, 70, 282, and 657 keV; Ga^{69}, 322 keV; Ga^{71}, 513 keV; Rb^{85}, 148 keV; Rb^{87}, 407 keV. Values of the reduced transition probability for excitation are given for each of the above gamma-rays. Level schemes are proposed based on coincidence studies and excitation curves. Bombardment of the enriched odd-A isotopes of tin, Sn^{115}, Sn^{117}, and Sn^{119}, produced no observable gamma-rays. A.

539.152.1

2532. THE LEVELS OF ^{19}F FROM INELASTIC NEUTRON SCATTERING. J.M.Freeman.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 591-604 (July, 1956).

The gamma-rays following inelastic neutron scattering in F^{19} have been studied as a function of neutron bombarding energy up to 2.2 MeV. The gamma-ray spectra in coincidence with radiation from

the lowest excited levels, at 111 and 196 keV, have also been measured near the thresholds for excitation of the higher levels. The following gamma-rays have been found: 1.236 ± 0.012 and 1.356 ± 0.012 MeV, in coincidence with 111 keV radiation; 1.360 ± 0.012 MeV, in coincidence with 196 keV radiation; 1.472 ± 0.016 MeV corresponding to a ground-state transition. The results are interpreted in terms of F^{19} levels at 1.557, 1.466 and 1.346 MeV. Branching ratios for the decay of each level to the ground, 111 keV and 196 keV states have been examined. No other levels up to 2.0 MeV have been found. A.

539.152.1

2533. PROTON-EXCITED ENERGY LEVELS IN ^{14}N. E.J.Burge and D.J.Prowse.
Phil. Mag. (Eighth Ser.), Vol. 1, 912-17 (Oct., 1956).

The nuclear energy levels of N^{14} have been investigated up to an energy of 7.7 MeV by inelastic proton scattering. All the known levels appear to participate in the scattering. The energies of the levels have been determined as: 7.60 ± 0.02, 7.40 ± 0.02, 7.03 ± 0.02 6.46 ± 0.02, 6.23 ± 0.02, 5.83 ± 0.03 and 5.69 ± 0.03 MeV. Some evidence was obtained for a level at 5.95 MeV, and a probable new level was observed at 6.60 ± 0.04 MeV. A.

539.152.1

2534. ROTATIONAL AND INTRINSIC LEVELS IN Tm^{169} AND Lu^{175}. E.N.Hatch, F.Boehm, P.Marmier and J.W.M.DuMond.
Phys. Rev., Vol. 104, No. 3, 745-52 (Nov. 1, 1956).

Nuclear levels in Tm^{169} excited by electron capture of Yb^{169}, and levels in Lu^{175} excited by both beta decay of Yb^{175} and electron capture of Hf^{175} have been studied by using the curved-crystal gamma-ray spectrometer and the ring-focusing beta-ray spectrometer, as well as a semicircular beta-ray spectrometer for low energies. From the precision energies and the multipolarity determinations, the levels in Tm^{169} have the following energies in keV, and spin and parity assignments: A (ground state) (1/2+), B 8.42 (3/2+), C 118.20 (5/2+), D 138.95 (7/2+). E 316.19 (7/2+), F 379.31 (7/2−), G 472.91 (9/2−). Levels A,B,C,and D are members of a rotational band whose characteristic constants are given. Levels E and F are interpreted as particle excitations and level G as a rotational level based on the state F. The Lu^{175} excited states have the following energies in keV, spins,and parities: A (ground state) (7/2+), B 113.81 (9/2+), C 251.46 (11/2+), D 343.40 (5/2+), E 396.31 (9/2−), F 432.76 (7/2+), G 504.7 (1/2+). A,B,and C form a rotational band for which the characteristic constants are given. Some features of the levels and transition probabilities are discussed and compared with the unified model. A brief survey of second-order rotational energy constants and of intrinsic excitation levels is given. A.

539.152.1

2535. LOW-LYING T = 0 LEVELS IN P^{30}. L.L.Lee,Jr and F.P.Mooring.
Phys. Rev., Vol. 104, No. 5, 1342-3 (Dec. 1, 1956).

The $S^{32}(d,\alpha)P^{30}$ reaction has been studied by magnetic analysis. A ground state Q value of 4.831 ± 0.013 MeV has been measured,with excited states at 0.693, 1.440 and 1.97 MeV excitation. The prominence of the 0.693 MeV level in this reaction indicates that it is probably T = 0, if isotopic spin selection rules may be considered valid. A.

539.152.1

2536. E0 TRANSITIONS IN NUCLEI. A.S.Reiner.
Physica, Vol. 22, No. 9, 843-4 (Sept., 1956).

A brief report of the conclusions of a refined theory of E0 transitions. A.O.Stanesby

539.152.2

2537. NUCLEAR MOMENTS [KERNMOMENTE]. H.Kopfermann. Second, revised edition. Frankfurt am Main: Akademische Verlagsgesellschaft (1956) xvi + 463 pp. In German.

Review in Nature (London), Vol. 178, 1016 (Nov. 10, 1956). "The book is essentially a manual for experimenters... ... Accounts are given of techniques in high-resolution optical spectroscopy, and in work on atomic- and molecular-beam magnetic and electric resonance, nuclear magnetic and electric quadrupole resonance, and paramagnetic resonance".

539.152.2

2538. NUCLEAR QUADRUPOLE RESONANCE IN METALS. W.D.Knight, R.R.Hewitt and M.Pomerantz.
Phys. Rev., Vol. 104, No. 1, 271 (Oct. 1, 1956).

Two resonance lines have been observed in gallium. These are attributed to Ga^{69} and Ga^{71}, and lead to a ratio of nuclear quadrupole moments which agrees with the value derived from atomic beam measurements. E.H.Sondheimer

539.152.2

2539. NUCLEAR SPIN OF AMERICIUM-241. R.P.Thorne.
Nature (London), Vol. 178, 484-5 (Sept. 1, 1956).

The 4662.8 and 4681.74 A lines in the AmI spectrum each show 6-component flag patterns under high resolution and it is concluded that the nuclear spin of Am^{241} is 5/2. M.A.Grace

539.152.2

2540. SPIN OF NEON-21. J.C.Hubbs and G.M.Grosof.
Phys. Rev., Vol. 104, No. 3, 715-17 (Nov. 1, 1956).

The spin of Ne^{21} has been shown to be 3/2 by the atomic beam magnetic resonance method utilizing the metastable $2p^5 3s\,^3P_2$ state of neon. The assignment is made from a comparison of Zeeman frequencies in Ne^{20} and Ne^{21} at the same magnetic field. A.

539.152.2

2541. SPIN OF RUBIDIUM-81 m. J.C.Hubbs, W.A.Nierenberg, H.A.Shugart and H.B.Silsbee.
Phys. Rev., Vol. 104, No. 3, 757-8 (Nov. 1, 1956).

The nuclear spin of 31.5 min $Rb^{81\,m}$ has been measured by the atomic beam resonance method. The result is I = 9/2. A.

539.152.2

2542. SPIN AND PARITY OF THE FIRST EXCITED STATE OF Na^{23}. W.G.Read and R.W.Krone.
Phys. Rev., Vol. 104, No. 4, 1018-20 (Nov. 15, 1956).

The angular distributions of the 440 keV gamma-radiation resulting from the $Na^{23}(p,p'\gamma)Na^{23}$ reaction have been measured for proton bombarding energies of 1.288 and 1.460 MeV. Decay by inelastically scattered protons is particularly favourable for these two well-isolated resonances in Mg^{24}. The results show a marked anisotropy, thereby ruling out the possibility that the first excited state of Na^{23} has spin J = ½. Otherwise the experiments do not permit a completely unambiguous assignment. Evidence is presented, however, showing that the most plausible assignment is J = 5/2+. A.

539.152.2

2543. SPIN AND MAGNETIC MOMENT OF Mn^{53}. W.Dobrowolski, R.V.Jones and C.D.Jeffries.
Phys. Rev., Vol. 104, No. 5, 1378-80 (Dec. 1, 1956).

The microwave paramagnetic resonance hyperfine structure of Mn^{53} has been observed in a powdered sample of $MnCl_2$ at 3 cm wavelength and 20°K. From the number of h.f.s. lines the nuclear spin is found to be $I(Mn^{53}) = 7/2$; from their spacing relative to those of Mn^{55}, the magnetic moment is found to be $|\mu(Mn^{53})| = 5.050 \pm 0.007$ nuclear magnetons. These results are discussed in relation to the nuclear shell model. A.

539.152.2

2544. SPINS OF CESIUM-127, CESIUM-129, AND CESIUM-130. W.A.Nierenberg, H.A.Shugart, H.B.Silsbee and R.J.Sunderland.
Phys. Rev., Vol. 104, No. 5, 1380-1 (Dec. 1, 1956).

The spins of three neutron-deficient radioactive isotopes of caesium have been measured by atomic beam methods. The results are: for 6 hr Cs^{127}, I = 1/2; for 31 hr Cs^{129}, I = 1/2; for 30 min Cs^{130}, I = 1. A.

539.152.2

2545. REVERSIBILITY AND IRREVERSIBILITY IN NUCLEAR RESONANCE. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 243, No. 17, 1201-3 (Oct. 22, 1956). In French.

Remarks on the irreversibility of the approach to equilibrium due to the spin–lattice interaction. A proof is announced which avoids repeated use of the random phase hypothesis. E.H.Sondheimer

539.152.2

2546. NUCLEAR MAGNETIC RESONANCE. QUADRUPOLE RELAXATION IN LIQUIDS. J.Seiden.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2715-18 (June 4, 1956). In French.

Theoretical expressions are given for the spin–lattice relaxation times of nuclei with quadrupole moments in terms of the correlation time of the field-gradient fluctuations. The cases I = 1 and I = 3/2 are discussed and the latter shown to lead to two distinct relaxation times. D.H.Whiffen

539.152.2

2547. NUCLEAR RESONANCE SATURATION EFFECTS AND MULTIPLE-QUANTUM TRANSITIONS. W.Anderson.
Phys. Rev., Vol. 104, No. 3, 850-1 (Nov. 1, 1956).

The power saturation of the proton nuclear magnetic resonance signals of 2-Br,5-Cl-thiophene is investigated and two lines shown

to saturate more rapidly than the other two in accordance with the theory of Bloch (Abstr. 6079/1956). At the highest powers a new line appears at the centre of the pattern which is attributed to double quantum transitions. D.H.Whiffen

539.152.2

2548. BLOCH EQUATIONS WITH DIFFUSION TERMS. H.C.Torrey.
Phys. Rev., Vol. 104, No. 3, 563-5 (Nov. 1, 1956).

The phenomenological Bloch equations in nuclear magnetic resonance are generalized by the addition of terms due to the transfer of magnetization by diffusion. The revised equations describe phenomena under conditions of inhomogeneity in magnetic field, relaxation rates, or initial magnetization. As an example the equations are solved in the case of the free precession of magnetic moment in the presence of an inhomogeneous magnetic field following the application of a 90° pulse with subsequent applications of a succession of 180° pulses. The spin-echo amplitudes agree with the results of Carr and Purcell from a random walk theory. A.

539.152.2 : 538.222 : 538.114

2549. NUCLEAR ALIGNMENT OF Co^{58}. D.F.Griffing and J.C.Wheatley.
Phys. Rev., Vol. 104, No. 2, 389-98 (Oct. 15, 1956).

By using a two-stage adiabatic demagnetization technique, Co^{58} nuclei were aligned in single crystals of (22.7% Cu, 77.3% Zn) $K_2(SO_4)_2 \cdot 6H_2O$ containing a trace of cobalt. Both the 0.805 MeV and 1.6 MeV gamma-rays were measured at three angles as a function of the paramagnetic susceptibility. The 1.6 MeV gamma-ray was determined to be quadrupole. A parameter λ related to the mixture of Fermi and Gamow–Teller interactions in the allowed beta-decay was determined to be 0.11 ± 0.04 in the transition to the 0.805 MeV level in Fe^{58} and 0.45 ± 0.11 in the transition to the 1.6 MeV level. By using the 0.805 MeV counting rate as a thermometer, the paramagnetic susceptibility was determined as a function of the absolute temperature and fitted to the formula $\chi(T) = (c/T)F(T)_{hfs}(1 + \Delta/T + \epsilon/T^2)$. The data indicate an antiferromagnetic interaction between copper ions, in disagreement with previous work. A.

539.153

2550. A 3 kMc/s APPARATUS FOR INVESTIGATING ELECTRONIC PARAMAGNETIC RESONANCE AND THE SIGN OF THE LANDÉ FACTOR. A.Charru.
C.R. Acad. Sci. (Paris), Vol. 243, No. 7, 652-4 (Aug. 13, 1956). In French.

The apparatus incorporates a TE_{11}-mode circular waveguide propagating circularly polarized waves. Preliminary results are given. E.P.Wohlfarth

539.153

2551. ON THE EXCITATION AND IONIZATION OF ATOMS BY α-EMISSION. F.Grard.
C.R. Acad. Sci. (Paris), Vol. 243, No. 10, 777-80 (Sept. 3, 1956). In French.

A theoretical treatment taking account of recoil effects confirms the probabilities of ionization and excitation calculated by Levinger (Abstr. 4332/1953). M.A.Grace

539.153 : 537.567

2552. DETERMINATION OF ELECTRON AFFINITIES BY EXTRAPOLATION. S.Geltman.
J. chem. Phys., Vol. 25, No. 4, 782-3 (Oct., 1956).

The affinity of an atom is obtained by extrapolation from the ionization potentials of n isoelectronic systems, n being regarded as a discrete variation parameter, so that the n giving maximum affinity is chosen. This procedure gives good agreement with experiment. J.Hawgood

539.153

2553. ATOMIC ENERGY LEVELS FOR THE APPROXIMATE THOMAS–FERMI POTENTIAL. T.Tietz.
J. chem. Phys., Vol. 25, No. 4, 789-90 (Oct., 1956).

With the analytical approximation to the Thomas–Fermi potential previously proposed (Abstr. 9025/1955) eigen-functions and eigenvalues for the Schrödinger equation are found. G.E.Brown

539.153

2554. CORRELATION SPLITTING IN HELIUM-LIKE IONS. H.Shull and P.O.Löwdin.
J. chem. Phys., Vol. 25, No. 5, 1035-40 (Nov., 1956).

The correlation effects in the ground state of the He-like ions are investigated by using the idea that the two electrons may occupy different orbitals in space. By using a scale factor η and a splitting parameter ν, a radial function $\varphi[r]$ is split into two different orbitals, $\varphi[\eta(1+\nu)r]$ and $\varphi[\eta(1-\nu)r]$, following Hylleraas (1929) and Eckart (1930). It is shown that by using orbitals obtained by splitting a simple exponential function, a surprisingly large amount of the radial correlation energy may be taken into account, whereas an attempt to split the atomic self-consistent field function for He led to a negative result. The lowest triplet state is also treated by using the same approach. A.

539.153

2555. PARAMAGNETIC RESONANCE SPECTROMETERS. J.Uebersfeld and E.Erb.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 90A-93A (June, 1956). In French.

Brief circuit details of two spectrometers working at 3 cm and 8 mm respectively. D.H.Whiffen

539.153

2556. HYPERFINE STRUCTURE OF THE METASTABLE STATE OF SINGLY IONIZED He^3. R.Novick and E.Commins.
Phys. Rev., Vol. 103, No. 6, 1897-8 (Sept. 15, 1956).

A beam of ions in the $2S_{\frac{1}{2}}$ (F = 0) state are obtained and magnetic dipole transitions to the $2S_{\frac{1}{2}}$ (F = 1) level are induced. The observed frequency allows one to separate off a small term arising from nuclear structure and nuclear interaction currents. G.E.Brown

539.153

2557. HYPERFINE STRUCTURE OF K^{39} IN THE 4P STATE AND OF Cs^{133} IN THE 6P STATE. P.Buck, I.I.Rabi and B.Senitzky.
Phys. Rev., Vol. 104, No. 2, 553 (Oct. 15, 1956).

The hyperfine structure of the $6P_{3/2}$ state in Cs and the $4P_{3/2}$ state in K are investigated with the atomic beam resonance method. In potassium, the method has to be modified to eliminate signals from another, stronger, transition in the neighbourhood. G.E.Brown

539.153

2558. HYPERFINE STRUCTURE OF Cu^{63} AND Cu^{65}. Y.Ting and H.Lew.
Phys. Rev., Vol. 105, No. 2, 581-8 (Jan. 15, 1957).

The hyperfine splittings of the electronic ground states of the stable copper isotopes Cu^{63} and Cu^{65} have been measured by the atomic beam magnetic resonance method. The magnitudes of these splittings are $\Delta\nu(Cu^{63}) = 11\,733.83 \pm 0.01$ Mc/s, $\Delta\nu(Cu^{65}) = 12\,568.81 \pm 0.01$ Mc/s, and their ratio is $\Delta\nu_{63}/\Delta\nu_{65} = 0.933\,567 \pm 0.000\,002$. If this ratio is compared with the ratio of the magnetic moments as measured by nuclear magnetic resonance, viz. $\mu_{63}/\mu_{65} = 0.933\,424 \pm 0.000\,019$, one finds a "hyperfine structure anomaly" of

$$\Delta = [\Delta\nu_{63}\cdot\mu_{65}/\Delta\nu_{65}\cdot\mu_{63}] - 1 = (0.015 \pm 0.002)\%.$$

Measurements of the "low-frequency" lines of the two isotopes yield the following values for the Landé g factors of the ground states: $g_J(Cu^{63}) = g_J(Cu^{65}) = (1.0000 \pm 0.0005)g_J(Cs^{133})$. A.

539.153

2559. ATOMIC SELF-CONSISTENT FIELD EQUATIONS. A.S.Kompaneets and E.S.Pavlovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 427-38 (1956). In Russian.

The Thomas–Fermi equation for the potential in an atom has been obtained together with all of the corrections of the order $Z^{-2/3}$ (Z = atomic number of the element) on basis of the Fock self-consistent field method. It is shown that the correction previously proposed by Weizsäcker is 9 times too large. The exchange correction previously found by Dirac is valid only as long as it is small compared with the main term in the potential. A.

539.153.4

2560. SELF-CONSISTENT FIELD CALCULATION FOR THREE CONFIGURATIONS OF ATOMIC IRON. F.Stern.
Phys. Rev., Vol. 104, No. 3, 684-91 (Nov. 1, 1956).

The Hartree self-consistent field method without exchange is used to calculate atomic wave-functions for the $3d^74s$ and $3d^8$ configurations of atomic iron, as well as for the $3d^64s^2$ configuration previously studied by Manning and Goldberg. Most sensitive to the change in configuration is the 3d electron, whose energy is −0.79, −0.50 and −0.34 Ry, respectively, in the $3d^64s^2$, $3d^74s$ and $3d^8$ configurations. The fraction of the charge of a 3d electron outside a sphere of radius $2.66a_0$ is 0.050, 0.095 and 0.160, respectively, for these configurations. The Racah parameters B, C and G_2 are evaluated from the wave-functions for all three configurations, and are also found for $3d^64s^2$ and for $3d^74s$ by a least squares fit of the spectroscopically observed terms. The two sets of values for B and C agree within 15%, but the value of G_2 calculated from the wave-functions exceeds the least squares value by almost 50% in $3d^74s$. Energies of the $3d^74s$ and $3d^8$ configurations relative to $3d^64s^2$, calculated from the wave-functions, are 0.25 and 0.65 Ry, respectively; the corresponding values deduced from the observed spectrum are 0.15 and 0.33 Ry. A.

539.153.4

2561. ANGULAR MOMENTUM DISTRIBUTIONS IN THE THOMAS–FERMI–DIRAC MODEL OF THE ATOM. T.A.Oliphant, Jr.
Phys. Rev., Vol. 104, No. 4, 954-8 (Nov. 15, 1956).

According to the Thomas–Fermi and the Thomas–Fermi–Dirac models of the atom, the electrons in an atom of a given Z have a given continuous distribution in angular momentum. Therefore, the question of how many s, p, d, or f electrons are to be found in an atom of a given Z cannot be answered by the statistical model as it stands. However, this question can be answered by assigning all the electrons which have values of angular momentum within a certain interval to a definite angular momentum quantum number l. There is, of course, some arbitrariness involved in selecting the method of angular momentum assignment. Fermi first calculated a set of curves for the numbers $\nu(l,Z)$ of s, p, d, and f electrons in an atom as a function of Z on the basis of a particular angular momentum assignment, and using the Thomas–Fermi statistical theory. Since the completion of Fermi's work, Dirac has modified the Thomas–Fermi theory to include the exchange effects of the electrons. In the present work, curves for $\nu(l,Z)$ have been calculated on the basis of the Thomas–Fermi–Dirac theory in order to investigate the effect on such curves of the exchange interaction between the electrons. Complete sets of curves have been found using the angular momentum assignment proposed by Fermi, and also using an angular momentum assignment proposed later by Jensen and Luttinger. Some isolated points on the $\nu(l,Z)$ curve have been plotted using a third angular momentum assignment. On the basis of the analysis of the graphs so obtained and their comparison with the empirical data, it is concluded that the exchange effects are not negligible for this calculation, that no simple angular momentum assignment such as the ones proposed by Fermi and by Jensen and Luttinger agrees well with the theory, and that it is probably possible by sufficient juggling to find an angular momentum assignment which would fit the empirical data reasonably well. A.

539.153.4

2562. RADIAL CONFIGURATIONAL INTERACTION IN HELIUM AND SIMILAR ATOMIC SYSTEMS. E.Holøien.
Phys. Rev., Vol. 104, No. 5, 1301-3 (Dec. 1, 1956).

The spherically symmetric component of the ground-state wave-functions of the two-electron series (H^-, He, Li^+, Be^{2+}, C^{4+}, O^{6+}, and Ne^{8+}) has been investigated by using the orthonormal complete set of $(2q+2)$-order associated Laguerre functions as radial orbitals in the method of superposition of configurations. The results for the total energies and the corresponding expansion coefficients demonstrate the excellent convergence properties of these functions. They are also useful practically since only one single-orbital exponent is used. Applied to excited quantum states, they indicate a more slowly convergent process. A.

539.153.4

2563. THE FERMI, OR EXCHANGE, HOLE IN ATOMS. V.W.Maslen.
Proc. Phys. Soc. A, Vol. 69, Pt 10, 734-40 (Oct., 1956).

Slater has recently introduced the concept of an averaged exchange hole as a basis for an approximation to the exchange potential, which arises in the Hartree–Fock equations. Use of the density matrix leads to a natural definition of the exchange hole which is identical with that obtained in a different manner by Slater. The distribution, size and shape of the exchange hole have been studied for neon and argon, using Slater wave-functions and the results give further information concerning the nature of the hole. The Slater approximation of a spherical exchange charge, centred at the electron, is discussed. A.

539.155.2

2564. SOME UPPER LIMITS OF ISOTOPIC ABUNDANCE. I. A, Mn, AND Cd. L.Kerwin.
Canad. J. Phys., Vol. 34, No. 10, 1080-1 (Oct., 1956).

The present status of the isotopic abundance of the above elements is given, including some species which have not been subject to previous search, and others which have previously been established as non-existent. H.C.Cole

539.155.2

2565. THE ISOTOPE COMPOSITION OF POTASSIUM FROM METEORITES. G.R.Rik and Yu.A.Shukolyukov.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 667-9 (1954). In Russian.

Mass-spectrograph analyses of a number of elements found in meteorites have given isotope compositions within the variations found for terrestrial specimens of those elements. Potassium of meteorite origin does not appear to have been previously studied with a mass spectrograph. Experimental details are outlined and discussed critically. Some 70-100 determinations of the $K^{39}:K^{41}$ ratio were carried out for each of three meteorites and a value of 14.4 ± 0.1 (0.07% error) was found. A determination of the ratio $K^{39}:K^{40}$ for one meteorite also gave the same value as for K of terrestrial origin. G.R.S.Manders

539.155.2

2566. ANALYSIS OF D_2O/H_2O BY THE INTERFEROMETER. S.Namba.
Rev. sci. Instrum., Vol. 27, No. 10, 872-3 (Oct., 1956).

Using a Riken interferometer (similar to the Jamin refractometer), D_2O has been determined for concentrations up to 6 mole% to a precision of about 0.1 mole%. Using white light a correction is necessary for the different dispersions. G.F.Lothian

RADIOACTIVITY. α-, β- AND γ-RAYS 539.16

539.16.08

2567. REDUCTION OF COUNTING TIME IN LOW ACTIVITY ASSAYS. H.A.Hughes.
Brit. J. appl. Phys., Vol. 7, No. 11, 415-18 (Nov., 1956).

Modification of a counting system can result in a reduction in background and sample counting rates. Such an arrangement will decrease the minimum counting time necessary to achieve a given fractional deviation in the net counting rate only under certain conditions. A method is described of determining these conditions. The application of this principle is exemplified in the use of a pulse amplitude analyser with a scintillation counter. A.

539.16.08

2568. A NEW CANADIAN PRIMARY RADIUM STANDARD. C.Garrett and K.W.Geiger.
Canad. J. Phys., Vol. 34, No. 10, 1075-6 (Oct., 1956).

The results of comparisons of the former standard with a recently acquired standard are reported. No significant discrepancy was found. J.J.Wilkins

539.162

2569. "INDICATIVE" FUNCTIONS OF SPECTRA. J.L.Destouches.
J. Phys. Radium, Vol. 17, No. 6, 475-9 (June, 1956). In French.

The continuous portion of a spectrum may be represented by the characteristic function of the complementary ensemble. The discontinuous portion may be represented by an indicative function (fonction indicatrice) whose zeros are the eigenvalues. Spectra may then be classified. The method applies also to quasi-stationary systems: the real part of a zero of the indicative function gives the energy level, while the imaginary part gives the decay constant. L.Pincherle

539.163

2570. RADIATIVE CAPTURE OF ORBITAL ELECTRONS. R.J.Glauber and P.C.Martin.
Phys. Rev., Vol. 104, No. 1, 158-75 (Oct. 1, 1956).

A theory is developed of the continuous radiation spectrum which accompanies nuclear capture of atomic electrons. It is shown that quantitative predictions of the spectrum intensities must take into account the influence of the electrostatic field of the nucleus on the radiation process. This is accomplished by evaluating and making use of a particularly simple form of the Green's function for electron propagation in a Coulomb field. In a first approximation which treats the atomic electrons nonrelativistically, the spectra radiated by electrons captured from S-states are shown at all energies to have the form $x(1-x)^2$, where $x = E/E_{max}$. Radiative capture of electrons from P-states is shown to produce a spectrum which becomes extremely intense at low energies, where it merges continuously with the characteristic X-ray spectrum. Certain relativistic corrections to the S-state radiative capture probablilities are evaluated and shown to bring about an energy-dependent reduction of the intensities of the corresponding spectra. Functions are tabulated from which the spectra for allowed capture from various orbital states of any element may be determined. The calculated spectra are found to be in satisfactory agreement with those observed experimentally. In particular, the unexpectedly high intensities found at low γ-ray energies are explained by the radiatively induced capture of electrons from P-states. A.

539.163

2571. RADIATIVE ORBITAL ELECTRON CAPTURE IN VANADIUM-49. R.W.Hayward and D.D.Hoppes.
Phys. Rev., Vol. 104, No. 1, 183-5 (Oct. 1, 1956).

The X-radiation and the continuous electromagnetic radiation

accompanying orbital electron capture in V^{49} have been studied by means of an argon–methane proportional counter and a well-type sodium iodide scintillation spectrometer. The observed pulse-height distribution was corrected for background, energy resolution, escape of degraded radiation from the crystal, gamma-ray detection and geometrical efficiency of the crystal, and absorption of the radiation between the source and detector. The transition energy of the V^{49} decay is 616 ± 10 KeV giving a total disintegration energy of 621 ± 10 keV. The half-life is measured as 327 ± 20 days, giving a log ft = 6.2, which is consistent with other allowed spectra with initial and final states in the $f_{7/2}$ shell. A.

539.163

2572. DECAY OF Cl^{39}. J.R.Penning, H.R.Maltrud, J.C.Hopkins and F.H.Schmidt.
Phys. Rev., Vol. 104, No. 3, 740-4 (Nov. 1, 1956).

The beta- and gamma-ray spectra of 55 min Cl^{39} were studied by means of magnetic and scintillation spectrometers. A first forbidden unique ($\Delta I = 2$, yes) beta transition takes place to the ground state of A^{39} in 7 ± 2% of all decays with an end-point energy of 3.45 ± 0.02 MeV and a log ft value of 7.8 (log f_1t = 8.3). Beta transitions to the second excited level of A^{39} at 1.52 MeV take place in 85 ± 6% of the transitions and have an end-point energy of 1.91 ± 0.02 MeV (log ft = 5.57). The remaining 8 ± 4% of the beta transitions take place to the first excited level at 1.266 MeV (log ft = 6.8). Three gamma-rays were found with energies of 0.246 ± 0.003, 1.266 ± 0.010 MeV, and relative intensities of 0.9 ± 0.1, 1, and 0.85 ± 0.05, respectively. The 0.240 and 1.266 MeV gamma-rays are in cascade. Each of the three gamma-rays is in coincidence with beta-rays with end-point energies of 1.90 ± 0.05 MeV. A beta–gamma delay is observed with a half-life of (0.95 ± 0.05) x 10^{-9} second. The metastable level is shown to be the second excited state. A decay scheme based on these data is proposed. A.

539.163

2573. ISOBARIC LEVEL STRUCTURE FOR A = 47. L.J.Lidofsky and V.K.Fischer.
Phys. Rev., Vol. 104, No. 3, 759-63 (Nov. 1, 1956).

The radioactive properties of Ca^{47}, Sc^{47} and V^{47} have been studied. Ca^{47} was found to have a half-life of 4.7 ± 0.1 days and to emit beta radiation in groups of 1940 ± 20 keV (17%) and 660 ± 10 keV (83%) maximum energy. Also observed in the decay were gamma-rays of energy 1.31 ± 0.02, 0.83 ± 02, and 0.48 ± 0.02 MeV and intensities in the ratio of 13 ± 2 : 1 ± 0.1 : 1, respectively. Sc^{47} emits a 160 ± 5 keV gamma-ray and beta-radiation in groups of 610 ± 5 keV (26%) and 450 ± 10 keV (74%) maximum energy. The gamma-ray spectrum of V^{47} was studied and an upper limit of 0.8% was set on the ratio of 160 keV gamma-rays to positrons. A.

539.163.08

2574. ON A RAPID METHOD FOR THE IDENTIFICATION AND MEASUREMENT OF RADIOACTIVE IMPURITIES. Y.Le Gallic.
C.R. Acad. Sci. (Paris), Vol. 243, No. 21, 1623-6 (Nov. 19, 1956). In French.

The method uses a plastic scintillation counter to discriminate between radiations of widely differing energies, e.g. for the detection of P^{32} in S^{35}. A.O.Stanesby

539.163.1

2575. THE HALF-LIFE OF MERCURY-203. G.G.Eichholz and J.V.Krzyzewski.
Canad. J. Phys., Vol. 34, No. 11, 1167-8 (Nov., 1956).

The decay of Hg^{203} was followed over 213 days using an ionization chamber. A value of 46.91 ± 0.14 days for the half-life was obtained. M.A.Grace

539.163.1

2576. MEASUREMENT OF THE HALF-LIFE OF RADON (Rn^{222}) BY CALORIMETRY. J. Robert.
J. Phys. Radium, Vol. 17, No. 7, 605 (July, 1956). In French.

The rate of heat production of a Rn source initially of 263 mc was followed over 15 days using an adiabatic microcalorimeter; the half-life obtained was 3.825 ± 0.004 days. A.O.Stanesby

539.163.1

2577. THE LIFETIME OF THE 200 keV EXCITED STATE OF ^{19}F. C.M.P.Johnson.
Phil. Mag. (Ser. 8), Vol. 1, No. 6, 573 (June, 1956).

Using NaI(Tl) scintillation counters and a delayed coincidence circuit the value of the mean life was (1.25 ± 0.025) x 10^{-7} sec. J.Hughes

539.163.1

2578. DETERMINATION OF THE LIFETIME OF THE 40-keV EXCITED STATE OF $_{81}Tl^{208}$ FOLLOWING ALPHA DECAY USING RECOIL SHIFTS OF THE CONVERSION ELECTRONS. J.Burde and S.G.Cohen.
Phys. Rev., Vol. 104, No. 4, 1093-8 (Nov. 15, 1956).

By using an alpha-particle–conversion-electron coincidence arrangement, a beam of moving recoil nuclei in vacuum is effectively selected. The momenta of electrons emitted from such moving nuclei into the acceptance angle of a lens spectrometer are shifted towards higher values. A thin stopping foil placed at a small distance from the source will or will not affect the momentum shifts according as the conversion electrons are emitted after or before the recoil nuclei are stopped in the film. A measurement of the momentum shift as a function of the distance of the stopping film from the source, thus permits an estimate of the lifetime to be obtained. In this way a value of (1.0 ± 0.5) x 10^{-12} sec has been obtained for the half-life. This value is about six times smaller than that to be expected theoretically for a magnetic dipole transition between the two component levels of the doublet belonging to the configuration $(s_{1/2}g_{9/2})$. A.

539.163.1

2579. NEW ISOTOPE EINSTEINIUM-248. A.Chetham-Strode and L.W.Holm.
Phys. Rev., Vol. 104, No. 5, 1314 (Dec. 1, 1956).

The new isotope E^{248} has been identified among the products of the deuteron bombardment of Cf^{249}. It decays principally by electron capture with a half-life of 25 ± 5 minutes and also by the emission of (6.87 ± 0.02) MeV alpha-particles. A branching ratio (E.C./α) of ~400 was determined from the amount of Cf^{248} formed by electron-capture decay of the new isotope. Partial excitation functions supporting the assignments to mass number 248 are presented. A.

539.163.1

2580. NEW ISOTOPES OF EINSTEINIUM. B.G.Harvey, A.Chetham-Strode,Jr, A.Ghiorso, G.R.Choppin and S.G.Thompson.
Phys. Rev., Vol. 104, No. 5, 1315-19 (Dec. 1, 1956).

The new isotopes E^{249}, E^{250}, E^{251} and E^{252} were produced by bombarment of Bk^{249} with helium ions. A recoil method was used to separate the bombardment products from the target material, so that the target could be used repeatedly. Approximate excitation functions for the formation of the einsteinium isotopes were measured as well as their half-lives, α-particle energies, and electron-capture branching ratios. A.

539.163.2 : 539.18

2581. MESONIC DECAY OF A LITHIUM HYPERFRAGMENT. O.Skjeggestad and S.O.Sörensen.
Phys. Rev., Vol. 104, No. 2, 511-12 (Oct. 15, 1956).

The mesonic decay of a nuclear fragment in a photographic emulsion is described. The event is most simply interpreted as the disintegration of a Li^{7*} hyperfragment according to the scheme $Li^{7*} \rightarrow He^4 + H^2 + H^1 + \pi^-$. The binding energy of the Λ^0 particle in the fragment is 4.4 ± 1.0 MeV. A.

539.163.2

2582. DECAY SCHEME OF Mo^{91}. F.B.Smith,Jr, N.B.Gove, R.W.Henry and R.A.Becker.
Phys. Rev., Vol. 104, No. 3, 706-10 (Nov. 1, 1956).

Gamma-radiation energies were measured at 1540 ± 20, 1210 ± 30, and 658 ± 3 keV, all of which decay with the known 65.5 sec half-life. Three positron groups were found to be involved in the same decay. The end-point energies of these were found to be 3.99 ± 0.05, 2.78 ± 0.10, and 2.48 ± 0.10 MeV. No gamma radiation was found decaying with the longer 15 min half-life. A single positron group with this longer half-life was found to have an end point of 3.44 ± 0.03 MeV. The long-lived positrons represent a transition between the ground states of Mo^{91} and Nb^{91}, whereas the 65 sec positions proceed from a 658 keV excited state of Mo^{91} to three excited states in Nb^{91}, the lowest of which is the well-known 104 keV excited state. The two higher excited states decay by gamma emission to this state. A.

539.163.2

2583. PSEUDOSCALAR INTERACTION IN THE DECAY OF ^{144}Pr. M.J.Laubitz.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 789-97 (Nov., 1956).

The ground-state beta-transition of Pr^{144} has been studied experimentally and the results analysed. The analysis depends upon the spin assumed for the ground state of Pr^{144}; if that state has spin and parity 0^-, as strong evidence indicates, then pseudoscalar interaction is needed to explain the results satisfactorily. The ratio of the coupling constants of pseudoscalar to tensor interactions required is approximately 100. A.

539.164

2584. REMARKS ON THE PARTICLES OF GREAT RANGE EMITTED BY RADIOELEMENTS. M.Ader.

J. Phys. Radium, Vol. 17, No. 5, 451-2 (May 1956). In French.

Further measurements on the long range particles (Abstr. 3147/1956) observed in nuclear emulsions associated with Po decay have been made. Those of range $< 100\,\mu$ are attributed to protons from α-particle bombardment of H and N: those of range $> 100\,\mu$ do not appear to have the same half-life as Po and are attributed to contamination. M.A.Grace

539.164.2

2585. THE RELATION BETWEEN α-DECAY AND NUCLEAR DEFORMATION. S.G.Rŷzhanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 332-3 (1956). In Russian.

Relation between the deformation of the nuclear surface and the relative intensities of α-groups from complex α-spectra of nuclei is established. When applied to RdAc spectrum (as an extra term in the Bethe–Gamow formula) it improves the agreement of theory with experiment. W.O.Lock

539.165./.166 : 539.152.1

2586. NUCLEAR LEVELS IN Dy^{161}. J.M.Cork, M.K.Brice, L.C.Schmid and R.G.Helmer.
Phys. Rev., Vol. 104, No. 2, 481-3 (Oct. 15, 1956).

A specimen of Gd^{160} enriched from its normal 21.9% up to 95.4% was irradiated in the Argonne heavy-water pile. The Gd^{161} formed by neutron capture decays by beta- and gamma-emission with a half-life of 3.7 min to radioactive Tb^{161}. Spectrometric studies of this activity show it to decay with a half-life of 7.15 days emitting both beta- and gamma-rays many of which previously have not been evaluated. There appear to be seven gamma-rays in Dy, all internally converted, whose energies are: 25.6, 27.7, 48.9, 57.3, 74.8, 78.3 and 106.2 keV. These energies fit into a scheme with nuclear levels at 25.6, 74.8, 103.9 and 132.0 keV. Coincidence data with the scintillation spectrometer support the proposed plan. The beta-spectrum, studied with the double focusing spectrometer, appears to be complex, having three components whose energies are 531, 447 and 405 keV, with relative intensities of 68%, 22% and 10%, and log ft of 6.7, 6.9 and 7.2, respectively. A.

539.165/166 : 539.152.1

2587. NUCLEAR ENERGY LEVELS OF Os^{188}. V.R.Potnis.
Phys. Rev., Vol. 104, No. 3, 722-7 (Nov. 1, 1956).

The beta and gamma radiations of the 18 hr Re^{188} have been examined with scintillation and magnetic spectrometers. Of the total beta disintegrations, 79% lead to the ground state, 20% to the first excited state at 155 keV, and 1% to the other excited states of Os^{188}. The beta-ray spectra leading to the ground state and the first two excited states of Os^{188} are first forbidden. Thirteen gamma-rays have been detected. Extensive gamma–gamma coincidence studies were made. The K-shell conversion coefficient of the 155 keV gamma-ray has been obtained which agrees quite well with the E2 assignment for that gamma-ray. The K/L ratio also supports this assignment. No conversion electrons corresponding to the 478 keV gamma-ray were found and it is concluded that it is primarily E2 in nature with a small admixture of M1 transition. A decay scheme is proposed on the basis of these data. A.

539.165

2588. RELATION BETWEEN ENERGY AND HALF-THICKNESS FOR ABSORPTION OF BETA-RADIATION. W.F.Libby.
Phys. Rev., Vol. 103, No. 6, 1900 (Sept. 15, 1956).

Using a cylindrical geometry of source, absorber and counter, exponential absorption of β-rays is obtained and a relation of the form $l_{1/2}(mg/cm^2) = 38 \times (E^{3/2})$ between the maximum β energy (E in MeV) and the halving thickness of Al ($l_{1/2}$) is found to hold. This relation may be extended to other absorber materials since $(l_{1/2})^{-1} \propto 1 + M/100$ where M is the mean atomic weight of the absorber. Some deviations are observed for forbidden spectra. M.A.Grace

539.165

2589. BETA DECAY OF Tb^{161}. W.G.Smith, J.H.Hamilton, R.L.Robinson and L.M.Langer.
Phys. Rev., Vol. 104, No. 4, 1020-5 (Nov. 15, 1956).

The radiations emitted in the beta decay of 7 day Tb^{161} have been studied with a 180°, 40 cm radius of curvature, shaped magnetic field spectrometer and a scintillation counter. Gamma–gamma coincidence measurements have also been made. The following transitions with multipolarities indicated were observed (energies in keV): 25.5(E1), 48.9(M1), 56.9(E1, tentative), and 74.6(E1). The following beta groups were also observed (energies in keV): 571, 522, 496, and 439. A level scheme incorporating these data is presented. A.

539.165

2590. A CALORIMETRIC DETERMINATION OF THE MEAN ENERGY OF THE β-SPECTRA OF P^{32}, S^{35}, Cu^{64}, W^{185} AND Au^{198}. N.S.Shimanskaya.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 393-6 (1956). In Russian.

The mean energies, E_β, of the β-spectra of P^{32}, S^{35}, Cu^{64}, W^{185} and Au^{198} have been determined calorimetrically. The following values of E_β for these isotopes were obtained: 693 ± 22; 52 ± 2; 213 ± 12; 144 ± 73 and 317 ± 15 keV. A.

539.165 : 537.533.75

2591. ABSORPTION COEFFICIENTS OF β-ACTIVE ISOTOPES. DOSAGE DISTRIBUTION AROUND SMALL RADIOACTIVE BODIES HAVING SURFACE EMISSION. K.Sommermeyer and K.H.Waechter.
Z. angew. Phys., Vol. 8, No. 10, 473-7 (Oct., 1956). In German.

Small-body high-atomic-number β-emitters are assumed to be surface radiators and their spectrum to approximate to that from thick air-equivalent layers in which the same isotope has been uniformly distributed. The reasoning of the authors' previous papers (Abstr. 718/1954 and 4611/1956) can be applied to this case. Experimental results for a small sphere and a small disk of Au^{198} and for a small Pb sphere having a P^{32}-active surface confirm this. D.V.Mabbs

539.165.08 : 539.166.08 : 535.37

2592. APPLICATION OF THE $CaSO_4$(Mn) PHOSPHOR IN DOSIMETRY. B.M.Nosenko, L.S.Revzin and V.Ya.Yaskolko.
Zh. tekh. Fiz., Vol. 26, No. 9, 2046-8 (1956). In Russian.

The authors discovered earlier (Voznesenskiĭ, Nosenko, Revzin, Yaskolko, Sbornik Trudov Sredne-Aziatskogo Gosudarstvennogo Universiteta, nov. ser., fizika, 23, 1955) that this phosphor is capable of storing the light-sum produced by cathode or X-ray excitation and to subsequently flash it up by heat. The phosphor was used for a β-(W^{185}) and γ-(Ag^{110} and Co^{60}) dosimetry. The merits of the phosphor are discussed. F.Lachman

539.165.2

2593. THE β-DISINTEGRATION OF RaD. W.Stanners and M.A.S.Ross.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 836-44 (Nov., 1956).

Electron-sensitive nuclear emulsion impregnated with RaD citrate was used. RaD events associated with β-particles of RaE were studied to determine the total number of developed grains produced in each RaD event. An analysis of the resulting grain-count distribution provides evidence of the occurrence of a ground-state to ground-state β-process in RaD with an intensity of 15.5 ± 3.5% of all disintegrations. The total intensity of excitation of the 46.5 keV state of RaE is thus 84.5 ± 3.5% and the intensity of conversion electrons from this state is 81 ± 4%. The last of these values is consistent with the previously published results. A.

539.166

2594. GAMMA–GAMMA ANGULAR CORRELATION IN W^{182}. R.C.Williams and K.I.Roulston.
Canad. J. Phys., Vol. 34, No. 10, 1087-8 (Oct., 1956).

The cascades 67.74 → 1222 keV, 152.4 → 1222 keV and 67.74 → 1122 keV have been studied by coincidence scintillation spectrometer. Spin assignments 2 → 2 → 0, 3 → 2 → 0 and 2(E1) → 2(90% E2, 10% M1) → 2 are established, and are shown to be consistent with the collective nuclear model if K-forbiddenness is taken into account. J.J.Wilkins

539.166

2595. COLLIMATION OF GAMMA-RADIATION BY A CIRCULAR CYLINDRICAL CHANNEL. C.Kellershohn and P.Pellerin.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 81A-84A (June, 1956). In French.

The distribution of γ-ray intensity produced by a radioactive source after collimation by a circular hole in a wall of absorbent material is calculated (taking into account attenuation, but not scattering, by the absorber). Numerical results are given for a 364 keV γ-ray source (I^{131}) plus lead collimator of variable thickness. Experimental results confirming the calculations are reported. J.J.Wilkins

539.166

2596. ON A 121 keV γ-RAY OBSERVED FROM A Pm^{147} SOURCE OF VERY HIGH PURITY. H.Langevin-Joliot and M.Lederer.
J. Phys. Radium, Vol. 17, No. 6, 497-8 (June, 1956). In French.

The source was purified by paper chromotography and electrophoresis. Using a scintillation spectrometer, a 121 keV γ-ray was found; with intensity $(3 \pm 0.5)\ 10^{-5}/\beta^-$ of Pm^{147}. This γ-ray was shown to be due to a Pm isotope of half-life $>\sim 1$ yr. J.J.Wilkins

539.166

2597. SOME OBSERVATIONS ON THE RADIOACTIVE TRANSFORMATION Tb^{161} (7 DAYS) → Dy^{161}. R. Ballini and R.Barloutaud.
J. Phys. Radium, Vol. 17, No. 6, 498-9 (June, 1956). In French.

Measurements with a solenoidal spectrometer are reported, indicating internal conversion lines at 46, 65 and 92 keV. It is shown that these new measurements are inconsistent with the decay scheme suggested earlier (Abstr. 9856/1955): in particular, the 74 keV γ-ray occurs in only 20-40% of the transformations. The information now available is not sufficient to establish a revised decay scheme. J.J.Wilkins

539.166 : 539.172.13

2598. ANGULAR DISTRIBUTIONS OF THE GAMMA RAYS FROM THE REACTION $Na^{23}(p,\gamma)Mg^{24+}$. F.W.Prosser,Jr, N.P.Baumann, D.K.Brice, W.G.Read and R.W.Krone.
Phys. Rev., Vol. 104, No. 2, 369-75 (Oct. 15, 1956).

Resonances occurring in the compound nucleus Mg^{24} resulting from the proton bombardment of sodium have been studied in the energy range from E_p = 0.58 to E_p = 1.50 MeV. Ten resonances were found to have a relatively large yield of capture gamma-rays. The cascades leading to the ground state of Mg^{24} were determined and found to proceed for the most part through well-known lower lying states. The angular distribution of the first gamma-ray emitted in the decay was measured for six of these resonances. The resonance energies in MeV and the corresponding assignments for spin and parity are the following: E_p = 0.595, 0.676, 0.740, 0.744, 0.877 (1+), 0.989 (4±), 1.022 (2−), 1.321 (3+), 1.398, 1.419 (4+). A.

539.166 : 539.172.13

2599. ANGULAR CORRELATION IN THE 2.86–0.72 MeV CASCADE IN B^{10}. S.M.Shaforth and S.S.Hanna.
Phys. Rev., Vol. 104, No. 2, 399-401 (Oct. 15, 1956).

The directional correlation in the 2.86–0.72 MeV cascade in B^{10} has been studied by utilizing the $Be^9(d,n)B^{10*}(\gamma)B^{10}$ reaction. At low bombarding energies and with thick targets the gamma–gamma correlation appears to be substantially independent of the preceding (d,n) reaction. With spins of 3 and 1 for the two low states of B^{10}, the observed correlation is consistent with the schemes: 2(93%D, 7%Q, 0 phase)1(Q)3; 2(Q)1(Q)3; 1(89%D, 11%Q, π-phase)1(Q)3, or (11%D, 89%Q, π phase)1(Q)3. A.

539.166 : 539.172

2600. PROMPT GAMMA RAYS ACCOMPANYING THE SPONTANEOUS FISSION OF Cf^{252}. A.B.Smith, P.R.Fields and A.M.Friedman.
Phys. Rev., Vol. 104, No. 3, 699-702 (Nov. 1, 1956).

Single- and multiple-crystal scintillation techniques are utilized to measure the energy spectrum of prompt gamma-rays emitted in the spontaneous fission of Cf^{252}. It is found that each fission yields an average of 10.3 photons having a total energy of 8.2 MeV. These photons are heterogeneous in energy. An upper limit is placed on the intensity of neutrons and quanta emitted in the order of 10^{-9} sec after fission. A.

539.166 : 539.172.13

2601. GAMMA RAYS FROM THE PROTON BOMBARDMENT OF PHOSPHORUS. B.D.Kern and L.W.Cochran.
Phys. Rev., Vol. 104, No. 3, 711-14 (Nov. 1, 1956).

The yield of gamma-rays has been obtained for proton energies from 0.4 to 2.0 MeV. There are seen in this region nineteen resonances, corresponding to energy levels in S^{32} at energies from 9.295 to 10.775 MeV. The energy spectra of the gamma-rays emitted at several of the resonances have been obtained and interpreted in terms of levels in the residual nucleus S^{32}. The spectra indicate that a 3.8 MeV gamma-ray is present; from a tentative assignment of it to the second excited state to ground state transition there follows the result that the second excited state of S^{32} has J = 1, even parity. A.

539.166

2602. SLOW-NEUTRON CAPTURE GAMMA RAYS FROM SODIUM AND CADMIUM. H.T.Motz.
Phys. Rev., Vol. 104, No. 5, 1353-64 (Dec. 1, 1956).

A thin-lens magnetic spectrometer has been used to observe the external conversion spectra of $Na^{23}(n,\gamma)Na^{24}$ and $Cd^{113}(n,\gamma)Cd^{114}$ and the internal conversion spectrum of $Cd^{113}(n,\gamma)Cd^{114}$ in the energy range of 300 keV to 3 MeV. An arrangement using an external neutron beam and one using a source located inside the reactor are compared. It is shown that target materials placed inside the reactor allow a better discrimination against background and permit the use of a K X-ray-conversion-electron coincidence scheme for photoelectric conversion which greatly simplifies the observed conversion spectrum. Four of the nine gamma-rays observed from sodium are assigned to transitions on the basis of the known energy levels from $Na^{23}(d,p)Na^{24}$, the other five are assigned to probable transitions on an energy and intensity basis. The internal conversion spectrum of Cd^{114} has disclosed a 0+ level at 1308 ± 3 keV and the de-excitation of this level by means of E2 transitions to other states in Cd^{114} is also observed. Three other states in Cd^{114} are proposed in addition to the well known 559 keV (2+) and 1286 keV (4+) states to explain the observed gamma-ray spectrum: 1212 ± 3 keV (2+ or 1+), 1368 ± 4 keV (2+ or 1+) and 1860 + 5 keV (4+ or 3+). A.

539.166

2603. GAMMA RADIATION FROM Co^{56} AND Co^{58}. C.S.Cook and F.M.Tomnovec.
Phys. Rev., Vol. 104, No. 5, 1407-10 (Dec. 1, 1956).

The gamma-rays following the decay of Co^{56} and Co^{58} have been observed by means of a large NaI(Tl) crystal scintillation spectrometer. Relative intensities of the Co^{56} gamma-radiation are presented as well as ratios of orbital electron capture to positron emission for both Co^{56} and Co^{58}. A.

539.166.08

2604. THE USE OF CdS PHOTORESISTANCES IN CONJUNCTION WITH PHOSPHORS AS DETECTORS OF GAMMA-RADIATION FROM COBALT-60. S.D.Margolin and I.G.Fakidov.
Dokl. Akad. Nauk SSSR, Vol. 105, No. 5, 976-7 (1955). In Russian.

CdS single crystals were used to detect scintillations from tolane, naphthalene, KI, CsI and NaI. The highest sensitivity, obtained with NaI, was > 150 that when the crystal was used as direct detector of Co^{60} radiation. The combination might be used to replace a scintillation counter in some applications. Brief results in measuring the thickness of steel sheet are described. Preliminary experiments indicated similar behaviour for 22 MeV gamma-radiation. C.H.L.Goodman

539.166.2

2605. SOME NOTES ON LOW-ENERGY GAMMA-RADIATION AT GREAT DEPTHS. M.Miesowicz, L.Jurkiewicz and J.M.Massalski.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 3, No. 7, 373-6 (1955).

Discussion of G-M counter observations confirms that the low-energy gamma-radiation observed at great depths is of local origin, and cannot be associated with cosmic radiation. J.J.Wilkins

539.166.2 : 539.152.1

2606. STUDY OF THE γ-RADIATION FROM THE DE-EXCITATION OF THE 8.06 MeV LEVEL IN N^{14}. P.Lehmann, A.Lévêque and R.Pick.
C.R. Acad. Sci. (Paris), Vol. 243, No. 9, 743-5 (Aug. 27, 1956). In French.

The ratio of transitions (from the 3.95 MeV level in N^{14}) to the ground state to transitions to the 2.31 MeV level is (5.5 ± 1) x 10^{-2}; the ratio of transitions (from the 8.06 MeV level) to the ground state to transitions to the first excited level at 2.31 MeV is about 20. A.O.Stanesby

539.166.2

2607. GAMMA RADIATION FROM THE DECAY OF $^{238}Pu_{94}$, $^{242}Cm_{96}$ AND $^{243}Cm_{96}$. J.O.Newton, B.Rose and J.Milsted.
Phil. Mag. (Eighth Ser.), Vol. 1, 981-1002 (Nov., 1956).

Accurate energy measurements on the gamma-rays from the decay of Pu^{238} and Cm^{242} have been made with proportional counters. Values of 43.49 ± 0.08 and 99.8 ± 0.4 and 153.1 ± 0.6 keV for Pu^{238}, and 44.03 ± 0.06, 101.80 ± 0.17 and 157.61 ± 0.3 keV for Cm^{242} were obtained. The ratios of these energies for each nuclide agree well with those predicted in the strong coupling limit of the unified model. Gamma-rays having energies of 210 ± 1.5, 228 ± 2 and 277 ± 2 keV and K–X radiation were found from the decay of Cm^{243}. These gamma-rays are shown to be magnetic dipole with a 30% mixture of electric quadrupole; the magnetic dipole component is 10^4 times slower than the single particle estimate. A.

539.166.2 : 539.18

2608. GAMMA RAYS FROM STRANGE PARTICLES.
S.L.Ridgway, D.Berley and G.B.Collins.
Phys. Rev., Vol. 104, No. 2, 513-17 (Oct. 15, 1956).

Strange-particle production by protons in the Cosmotron range of energies was studied by observing gamma-rays resulting from the decay of these particles at distances a few centimetres from the bombarded target. A laboratory energy threshold of 1.1 ± 0.1 BeV was measured for protons on a copper target, consistent with the hypothesis of associated production. A free-particle threshold is estimated. The production below threshold, at 1.0 BeV, is less than 10^{-2} of the 2.9 BeV production. The mean survival distance for particles produced at 1.7 BeV is 3.8 cm. Upon analysis this yields a

lifetime which matches the one known for the θ^0 and suggests $\theta^0 \rightarrow 2\pi^0$. Unless the Λ^0 is produced with a strongly ($\cos^2\theta$) peaked forward and backward angular distribution, it cannot be the dominant source of the gamma-rays. Under the assumption that these particles are hyperons or heavy mesons, the total cross-section, of that component which decays via π^0 mesons, is 0.1 mb per carbon nucleus. A.

539.166.74

2609. SEPARATION OF THE CROSS SECTION FOR SCATTERING OF PHOTONS BY PROTONS INTO SPIN–FLIP AND NON-SPIN–FLIP PARTS. R.Gomez and D.Walecka.
Phys. Rev., Vol. 104, No. 5, 1479-81 (Dec. 1, 1956).

The spin–flip and non-spin–flip scattering amplitudes of the differential cross-section for Compton scattering by protons are presented, and the corresponding cross-sections are also given. A.

539.166.83

2610. EVIDENCE FOR REDUCTION OF M1 K-SHELL INTERNAL CONVERSION COEFFICIENT. F.K.McGowan and P.H.Stelson.
Phys. Rev., Vol. 103, No. 4, 1133-4 (Aug. 15, 1956).

This coefficient has been determined for the nuclei Ta^{181}, Re^{187}, Au^{197} and Tl^{203}. The values reported are between 0.65 and 0.79 of the corresponding theoretical values, calculated for point nuclei. The techniques used included measurements of the K X-ray and γ-ray yields produced by α-particle Coulomb excitation.

J.J.Wilkins

539.166.83

2611. INTERNAL CONVERSION IN Hg^{198}. J.Volpe and G.Hinman.
Phys. Rev., Vol. 104, No. 3, 753-6 (Nov. 1, 1956).

The K-shell conversion coefficients of the 676 keV and the 1088 keV gamma-rays of Hg^{198} have been measured to be $\alpha_K(676) = 0.019 \pm 0.005$ and $\alpha_K(1088) = 0.0046 \pm 0.0006$. The 676 keV gamma-ray is shown to be a mixture of M1 and E2 radiations in approximately equal amounts. A.

539.166.83

2612. SPECTRUM OF L AUGER ELECTRONS FROM $_{81}Tl^{208}$ AND $_{83}Bi^{212}$. J.Burde and S.G.Cohen.
Phys. Rev., Vol. 104, No. 4, 1085-92 (Nov. 15, 1956).

A study of the L Auger spectrum emitted from a source of ThB in equilibrium with its decay products has been made by using a thin-magnetic-lens electron spectrometer. The L Auger spectrum coincident with alpha-particles has also been measured, and this has been ascribed mainly to Tl^{208}. Since the directly recorded L Auger spectrum is composed mainly from the L spectra of Tl^{208} and Bi^{212}, the latter spectrum could be obtained by subtraction of the properly normalized alpha coincident spectrum from the directly recorded spectrum. The importance of the effect of nuclear recoil accompanying alpha emission on the shape and energies of the L Auger spectra is discussed and properly taken into account. The energies and intensities of fifteen lines are given for each spectrum, and a classification of these lines are made. From the experimental results the Auger and Coster–Kronig yields for the different L subshells were calculated. A.

539.166.83

2613. CORRECTIONS TO INTERNAL CONVERSION COEFFICIENTS FOR LOW-Z ELEMENTS. G.W.Hinman.
Phys. Rev., Vol. 104, No. 5, 1332-3 (Dec. 1, 1956).

The internal conversion coefficients for gamma-rays depend only on the value of the initial-state wave-function at the origin, to a good approximation for light nuclei and high energies where the relativistic approximation of Dancoff and Morrison is valid. Corrections for shielding can be made in this region by using the many calculations available of Hartree–Fock electron wave-functions. A.

539.166.83

2614. EFFECT OF THE FINITE NUCLEAR SIZE ON INTERNAL CONVERSION. E.L.Church and J.Weneser.
Phys. Rev., Vol. 104, No. 5, 1382-6 (Dec. 1, 1956).

It is shown that the finite nuclear size introduces additional nuclear matrix elements into the expression for the rate of internal-conversion-electron ejection which are distinctly different from that for gamma-ray emission of the same multipole order. To illustrate the effect of these new matrix elements, the correction to the K-conversion coefficient of magnetic-dipole transitions is calculated. It is shown that in cases where the gamma-ray matrix element is attenuated (e.g., 1-forbidden M1 transitions and the M1 components in odd-A rotational transitions), the new nuclear matrix elements may lead to appreciable deviations between the experimentally measured K-shell conversion coefficient and the theoretical calculations of Sliv. The conversion coefficients of other electric and magnetic transitions are also affected by the introduction of the new matrix elements, as well as angular-correlation measurements involving the conversion electrons. A.

539.166.835

2615. MAGNETIC QUENCHING OF 3-PHOTON ANNIHILATION IN SOLIDS. V.L.Telegdi, J.C.Sens, D.D.Yovanovitch and S.D.Warshaw.
Phys. Rev., Vol. 104, No. 4, 867-73 (Nov. 15, 1956).

It is shown experimentally that the rate of the 3-photon annihilation of positrons in amorphous insulators exhibiting a long-lifetime component in 2-photon decay (Teflon, fused quartz) is quenched in the presence of an external magnetic field, while the rate in aluminium is unaffected. This effect has been studied in fields up to 10^4 gauss. The results can tentatively be explained by a simple theory which assumes: (a) that in metals, all or most positrons do not form bound systems; (b) in amorphous insulators a certain fraction of positrons form 1S positronium, the rest annihilating directly; (c) in amorphous insulators such as Teflon and fused quartz, positronium atoms, or at least their ortho-variety, exhibit essentially vacuum intrinsic properties and are subject to a rapid destruction due to ortho $\leftrightarrow$ para conversion and/or "pickoff" annihilation. Besides the (vacuum) ortho and para annihilation rates, the sole parameter of this theory is the "conversion" rate γ. The values of γ determined from the present experiment agree within 10% with those required to explain the lifetimes observed in these materials by Bell and Graham. Accurate relative 3-photon annihilation rates have also been obtained: (Teflon/Al) = 3.08 ± 0.15; (fused quartz/Al) = 2.29 ± 0.09. A.

539.167 : 550.42

2616. ON THE NUCLEAR PHYSICAL STABILITY OF THE URANIUM MINERALS. P.K.Kuroda.
J. chem. Phys., Vol. 25, No. 4, 781-2 (Oct., 1956).

The occurrence in the presence of water of natural critical assemblies of U minerals is considered as a possible explanation of the absence of large U deposits $> 2 \times 10^9$ yr old and of the marked discrepancies between the Pb^{206}/U^{238} and Pb^{207}/Pb^{206} ages of U minerals. A.O.Stanesby

539.167.3

2617. PREPARATION OF Hg^{203} WITH HIGH SPECIFIC ACTIVITY BY MEANS OF THE SZILARD–CHALMERS REACTION. M.Bruno and U.Belluco.
Ricerca sci., Vol. 26, No. 8, 2384-9 (Aug., 1956). In Italian.

To obtain such radionuclides with high specific activity, the possibility of making use of a Szilard–Chalmers reaction, by bombarding with neutrons the metallo-organic mercury compound, constituted of the internal ortho-oxy-mercuriobenzoic acid salt was examined. This compound, insoluble in water, was thought suitable for the purpose, because it does not give some of the most usual reactions of mercuric salts, nor does it give rise to heterogeneous isotopic exchange with mercuric nitrate in aqueous solution at room temperature. After the bombardment, the compound is not altered in such a way as to contain measurable quantities of ionic mercury. The radionuclide thus formed in an ionic state within the compound was partly extracted by putting the compound in contact with a diluted solution of mercuric nitrate or nitric acid. From the measurement of the radioactivity, it was ascertained that such a method allowed the preparation of the radionuclide Hg^{203} with very high specific activity. A.

NUCLEAR REACTIONS 539.17

539.172

2618. RADIOCHEMICAL MEASUREMENTS OF THE NATURAL FISSION RATE OF URANIUM AND THE NATURAL OCCURRENCE OF THE SHORT-LIVED IODINE ISOTOPES. P.K.Kuroda, R.R.Edwards and F.T.Ashizawa.
J. chem. Phys., Vol. 25, No. 3, 603 (Sept., 1956).

Iodine isotopes were separated from a uranium sample and their activity measured. The spontaneous fission half-life of U^{238} was estimated as $(1.03 \pm 0.10) \times 10^{16}$ yr. A.O.Stanesby

539.172 : 539.18

2619. ON THE NATURE OF PARTICLES PRODUCED IN EXTREMELY ENERGETIC NUCLEAR COLLISIONS. F.A.Brisbout, C.Dahanayake, A.Engler, Y.Fujimoto and D.H.Perkins.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 605-21 (July, 1956).

A detailed investigation into nuclear collisions of energy between 10^{12}-10^{13} eV is reported. The ratio of π^0-mesons to charged shower particles has been determined with high statistical accuracy

yielding a value R = 0.383 + 0.044. The central cores of the "jets" have been carefully scanned to detect secondary interactions produced by the shower particles and the ratio, Q, of the number of interactions produced by neutral to the number produced by charged shower particles has been obtained. Q = 0.25 + 0.09. If we assume that in nuclear collisions of very high energy, neutral and charged particles (other than π-mesons) are created in approximately equal numbers and that the interaction mean free path for such particles does not differ appreciably from that of π-mesons, the values R and Q enable an estimate to be made of the fraction of shower particles which are not π-mesons. The results indicate that ~25% of the shower particles must be heavy mesons, hyperons, nucleon–antinucleon pairs, and ejected nucleons. In order to estimate the contribution to the above fraction from heavy mesons, a detailed analysis of the products of secondary disintegrations has been carried out. The results, although preliminary, are compared with those of Dahanayake et al. (Abstr. 6517/1955) and are consistent with the assumption that most of these unidentified shower particles in the core are heavy unstable particles. The lifetime of the π^0-meson has been determined by a method which does not involve the determination of the energy of the meson. The mean life obtained is $1.8^{+3.2}_{-1.1} \times 10^{-15}$ sec. A.

539.172

2620. ANGULAR DISTRIBUTION OF NUCLEAR REACTION PRODUCTS. G.R.Satchler.
Phys. Rev., Vol. 104, No. 4, 1198-200 (Nov. 15, 1956).

Formulae given in an earlier paper (Abstr. 7671/1954) are corrected, and are generalized to include interference between two or more levels of the compound nucleus. J.J.Wilkins

539.172 : 537.591.5

NUCLEAR DISINTEGRATIONS OF LIGHT ELEMENTS IN THE STRATOSPHERE. See Abstr. 2379

539.172 : 537.591.8

COLLISIONS OF HIGH-ENERGY NUCLEONS WITH NUCLEI. See Abstr. 2390

539.172 : 539.166

PROMPT GAMMA RAYS ACCOMPANYING THE SPONTANEOUS FISSION OF Cf^{252}. See Abstr. 2600

539.172

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.172

2621. NUCLEAR INTERACTIONS OF π^--MESONS IN COPPER. N.M.Kocharyan, G.S.Saakyan, M.T.Alvazyan, Z.A.Kirakosyan and A.S.Aleksanyan.
Dokl. Akad. Nauk SSSR, Vol. 105, No. 6, 1204-7 (1955). In Russian.

Star production, nuclear scattering and stopping are observed for about 500 π^--mesons of different energies produced by cosmic rays. The total cross-section is found to be only slightly above geometrical (with a nuclear radius of $1.4 \times 10^{-13} A^{1/3}$ cm) and to be almost independent of energy in the region investigated of 510 MeV to > 6 BeV. G.E.Brown.

539.172

2622. π^-–p INTERACTIONS IN THE 1.0-BeV REGION. W.D.Walker, F.Hushfar and W.D.Shephard.
Phys. Rev., Vol. 104, No. 2, 526-35 (Oct. 15, 1956).

450 π^-–p collisions of energy about 1 BeV were examined. About one third of these have been found in emulsion and the rest in the Brookhaven hydrogen diffusion chamber. About one half of the total cross-section at this energy comes from elastic processes. The differential elastic cross-section is characterized by a sharp peak in the forward direction and considerable bump in the backward hemisphere. It is believed that a considerable portion of the elastic cross-section is produced by refraction rather than diffraction. The target radius of the nucleon at this energy seems to be $\geq 1.1 \times 10^{-13}$ cm which is essentially the same result that has been found at 1.4-1.5 BeV. The inelastic processes seem to exhibit somewhat different features at this energy from those at 1.5 BeV. The angular distributions of all products are almost isotropic. The nucleons seem to slightly prefer the backward hemisphere but not so nearly the same degree as found at 1.5 BeV. The π^- seem to lose most of their energy in the inelastic processes and this too is somewhat different from the 1.5 BeV results. The momentum change spectrum for the nucleons is nearly the same at 1.0 and 1.5 BeV. These results are discussed in terms of the Dyson–Takeda model which introduces a pion–pion interaction. A possible isobar formation is also discussed. A.

539.172

2623. INTERACTION OF π^--MESONS WITH LEAD, COPPER, CARBON AND BERYLLIUM NUCLEI. A.E.Ignatenko, A.I.Mukhin, E.B.Ozerov and B.Pontekorvo (Pontecorvo).
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 545-9 (1956). In Russian.

The total interaction cross-sections σ_t for π^--mesons with Be, C and O nuclei and the cross-section σ_{in} for inelastic collisions of π^--mesons with Be, C, Cu und Pb nuclei in the 140-400 MeV energy range have been measured. The cross-sections were determined by scintillation counter measurements of the attenuation of a flux of mesons passing through a scatterer. The energy dependence of σ_t and σ_{in} resembles in general the energy dependence of the total π-meson scattering cross-section on hydrogen and deuterium. The results of measurement of the cross-sections are analysed using the optical model. It can be concluded from the analysis that an optical model with parameters computed on the basis of the single-nucleon mechanism of interaction between π^--mesons and nuclei satisfactorily describes the energy dependence of the cross-sections in the 140-400 MeV energy range. A.

539.172.1

2624. SPALLATION—FISSION COMPETITION IN HEAVIEST ELEMENTS; HELIUM-ION-INDUCED REACTIONS IN PLUTONIUM ISOTOPES. R.A.Glass, R.J.Carr, J.W.Cobble and G.T.Seaborg.
Phys. Rev., Vol. 104, No. 2, 434-47 (Oct. 15, 1956).

Excitation functions have been determined for the spallation and fission reactions induced in plutonium isotopes by 20 to 50 MeV helium ions. The method employed consists of cyclotron bombardments of plutonium oxide followed by the chemical isolation and alpha- or beta-counting of radioactive reaction products. Formation cross-sections are given where possible for the curium and americium spallation products corresponding to (α,n), $(\alpha,2n)$, $(\alpha,3n)$, $(\alpha,4n)$, $(\alpha,5n)$, (α,p), $(\alpha,pn$ or $d)$, $(\alpha,p2n$ or dn or $t)$, and $(\alpha,p3n$ or d2n or $tn)$ reactions in Pu^{238}, Pu^{239} and Pu^{242}. Fission yield curves and fission cross-sections for Pu^{238} and Pu^{239} serve to define the characteristics of the (α,f) reaction for plutonium isotopes. Chemical procedures are outlined for the separation of both spallation and fission-product elements in a sequence of operations performed on the entire dissolved target. The small spallation and large fission cross-sections observed indicate that fission competes successfully for most of the total reaction cross-section in the energy range studied. Analysis from a compound nucleus viewpoint of the cross-sections for the surviving (α,xn) products reveals mean Γ_f/Γ_n values for compound and intermediate compound nuclei from 1 to 7, the value decreasing with increasing mass number and apparently not greatly dependent on excitation energy above fission and neutron-emission thresholds. The relatively high cross-sections ("tails") evident in the spallation excitation functions beyond their maxima constitute evidence for processes other than compound nucleus formation, e.g., direct interaction. Even more convincing evidence for noncompound-nucleus processes is seen in the fact that the cross-sections for (α,pxn) reactions are of the same order of magnitude as (α,xn) cross-sections. Their explanation rests strongly on the supposition that the ejection of high-energy protons, deuterons, and tritons occurs leading to residual intermediate nuclei of low excitation energy, which then excape from fission. This unique description of the escape of charged particle emission reactions from fission competition is believed to have wide application for the explanation of spallation cross-section data in the heaviest element region. Fission yield curves for Pu^{238} and Pu^{239} have been constructed from the production cross-sections (mass chain yield plus direct production) for the isotopes $Br^{82,83}$, $Sr^{89,91,92}$, Ru^{105}, $Cd^{115,115m,117}$, $I^{131,133}$, $Ba^{139,140}$, $Ce^{143,145}$, Nd^{147}, $Eu^{156,157}$ and Tb^{161}. The more complete curves for Pu^{239} show a change with increasing energy from asymmetric to symmetric fission for about 40 MeV helium ions accompanied by an increase in number of neutrons lost, as determined by the best fit of reflection points. Integration of the fission yield curves gives total fission cross-sections for various energies which, when combined with the appropriate total spallation cross-sections, define a total reaction cross-section function consistent with a nuclear radius parameter in the range of $(1.3\text{-}1.6) \times 10^{-13}$ cm. Further investigations in the present series should elucidate the effects of Z and A upon fission competition. A.

539.172.1

2625. STUDY OF THE REACTION MECHANISM FOR (He^3,p) REACTIONS WITH Li^6, B^{10}, AND C^{13}. J.P.Schiffer, T.W.Bonner, R.H.Davis and F.W.Prosser,Jr.
Phys. Rev., Vol. 104, No. 4, 1064-8 (Nov. 15, 1956).

Excitation curves and angular distributions have been obtained for five (He^3,p) reactions in which the initial and final states were of

known spins and parities. The results give information on the reaction mechanisms involved. All the reactions studied showed resonances in the excitation curves indicating that the reactions proceeded at least in part by way of a compound system. In one or possibly two cases, the angular distributions showed a strong asymmetry about 90°, suggesting the admixture of some other reaction mechanism. A.

539.172.1

2626. DIFFERENTIAL CROSS SECTIONS FOR THE $Be^9(He^3,p)B^{11}$ REACTION. H.D.Holmgren, M.L.Bullock and W.E.Kunz.
Phys. Rev., Vol. 104, No. 5, 1446-50 (Dec. 1, 1956).

The differential cross-sections for four highest energy proton groups from the $Be^9(He^3,p)B^{11}$ reaction have been measured at a bombarding energy of 2.00 MeV over the angular region extending from 5° to 170°. In order to fit these data with Legendre polynomial expansions, it was necessary to include polynomials up to the sixth degree. The coefficients in these expansions are tabulated for each proton group. These results by themselves are not inconsistent with the compound nucleus model of nuclear reactions, but when viewed in connection with other results, they indicate the possibility that direct interactions may play an important part in He^3-induced reactions. A.

539.172.1

2627. NUCLEON TRANSFER AND VIRTUAL COULOMB EXCITATION. G.Breit and M.E.Ebel.
Phys. Rev., Vol. 104, No. 4, 1030-46 (Nov. 15, 1956).

A semiquantitative explanation of the experiments of Reynolds and Zucker on transfer reactions arising in the collision of N^{14} with N^{14} is arrived at, making use of the effect of Coulomb excitation to virtual levels. These excitations are shown to be important even though a permanent separation of nuclei in Coulomb excited states may be energetically impossible. The process is of sufficient generality to have application to other similar reactions. An analysis of the experimental material shows that the process is probably important in the case of the $N^{14} + N^{14}$ reactions for all energies below that required for contact between nuclear surfaces and that it is probably the only important process at bombarding energies below 15 MeV. A.

539.172.1

2628. INTERACTION OF NITROGEN NUCLEI WITH PHOTOGRAPHIC EMULSION NUCLEI. D.M.Parfanovich, N.V.Rabin and A.M.Semchinova.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 188-93 (1956). In Russian.

Experiments on the interaction of 100 MeV nitrogen nuclei with photographic emulsion nuclei are described. The energy range dependence of nitrogen nuclei in the photographic emulsion has been determined. The energy and angular distributions of protons and α-particles created in the reactions have been studied. Some peculiarities in the interaction between the nitrogen nucleus and photographic emulsion nuclei have been found which cannot be explained by the compound nucleus theory. A.

539.172.11/.13

2629. STUDY OF THE $C^{14}(p,n)N^{14}$ AND $C^{14}(\alpha,n)O^{17}$ REACTIONS. R.M.Sanders.
Phys. Rev., Vol. 104, No. 5, 1434-40 (Dec. 1, 1956).

Targets of 38.7% C^{14}, deposited from a glow discharge in acetylene, were used for the determination of the following threshold energies: $C^{14}(p,n)N^{14}$, 671.5 ± 0.5 keV; $C^{14}(p,n)N^{14}$, 3149.6 ± 1.1 keV; $C^{14}(\alpha,n)O^{17}$, 2340 ± 3 keV. Corresponding reaction energies are −626.4 ± 0.5, −2938.3 ± 1.0, and −1820 ± 2 keV. The latter two thresholds were detected by the counter-ratio technique. The $C^{14}(p,n)N^{14}$ excitation curve was extended to 3.4 MeV, covering a resonance at 2908 ± 4 keV with a natural width of 71 ± 5 keV. Resonance energies agree with previous experimental results but the widths are larger, perhaps due to target thickness errors. Absolute cross-sections are compared with those of $N^{14}(n,p)C^{14}$. Compound nucleus spins and partial widths are calculated. $C^{14}(\alpha,n)O^{17}$ resonances with energies and natural widths of 2553 ± 4, 1.6 ± 1; 2642 ± 3, 10 ± 1; (2798 ± 11, 22 ± 10)?; 3335 ± 15, 100 ± 20; and 3508 ± 4, 54 ± 3 keV were observed. The 0° differential cross-section at 2642 keV is 31 mb/sterad ± 60%. An angular distribution taken at this resonance leads to a total cross-section of 300 mb and a compound-nucleus spin of either 1^- or 3^-. A method is presented for evaluating resonance width, height, and area to find target thickness and natural width. A.

539.172.11 : 539.152.2

2630. THE REACTION $^9Be(\alpha,n)^{12}C$. D.B.James, G.A.Jones and D.H.Wilkinson.
Phil. Mag. (Eighth Ser.), Vol. 1, 949-63 (Oct., 1956).

The angular properties of the reaction $Be^9(\alpha,n)C^{12}$ have been investigated in some detail in the range E_α = 0.4 to 1.3 MeV. Analysis of the results in terms of overlapping resonances has led to tentative assignments of spin and parity to certain levels in C^{13}. The possibility that the reaction may proceed partly by a stripping mechanism has been considered; it has been concluded that the results do not specifically demand such a mechanism. A.

539.172.11

2631. ON THE REACTION $^{13}C(\alpha,n)^{16}O$. M.G.Rusbridge.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 830-5 (Nov., 1956).

The reaction $C^{13}(\alpha,n)O^{16}$ has been examined from 1.0 to 2.5 MeV bombarding energy. The positions and widths of seven resonances have been measured. Angular distributions have been obtained in five cases, and some tentative spin and parity assignments made. Measurements of the absolute cross-section are given and values of reduced neutron and alpha-particle widths have been calculated for three levels in O^{17}. A.

539.172.13

2632. ELASTIC SCATTERING OF PROTONS BY BERYLLIUM. F.S.Mozer.
Phys. Rev., Vol. 104, No. 5, 1386-98 (Dec. 1, 1956).

Fifteen angular distributions and three excitation curves for the reaction $Be^9(p,p)$ have been obtained in the proton energy region between 200 and 3000 keV. Angular distributions for $Be^9(p,d)$ and $Be^9(p,\alpha)$ at 333 keV were also measured. The elastic scattering data has been analysed and fitted in terms of the following states in B^{10}; and s-wave $J = 1^-$ state near 330 keV proton bombarding energy; a p-wave $J = 2^+$ state near 980 keV; an s-wave $J = 2^-$ state near 998 keV; a p-wave $J = 0^+$ state near 1084 keV; and an s-wave $J = 2^-$ state near 1330 keV. A.

539.172.13 : 539.152.1

2633. ON THE PRESENCE OF DIFFERENT TRANSIENT SUBSTRUCTURES IN THE NUCLEUS OF C^{12}. A.Samman.
C.R. Acad. Sci. (Paris), Vol. 242, No. 26, 3062-4 (June 25, 1956). In French.

Continuation of earlier work (Abstr. 7673/1956). A further study was made of 19 disintegrations $C^{12}(p,p')\,3\alpha$; these are accounted for as follows: 9 as single scattering by a bound nucleon, 6 as single scattering by nuclear substructures ^2M and ^3M, and 4 as multiple scattering. A.O.Stanesby

539.172.13

2634. EMISSION OF A PHOTON IN THE CAPTURE OF A FAST PROTON BY A NUCLEUS. A.I.Akhiezer and I.Ya.Pomeranchuk.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 821-3 (1954). In Russian.

The cross-section for this process is calculated under the assumption that the proton may be described by a Dirac equation and that the nucleus may be regarded as completely black. G.Martelli

539.172.13

2635. NUCLEAR INTERACTIONS OF HIGH-ENERGY PROTONS IN COPPER. N.M.Kocharyan, G.S.Saakyan, M.T.Aĭvazyan, Z.A.Kirakosyan and A.S.Aleksanyan.
Dokl. Akad. Nauk SSSR, Vol. 107, No. 5, 668-70 (1956). In Russian.

Using a magnetic spectrograph described earlier (Abstr. /1957) momenta of π^+-mesons and protons are selected. The inelastic cross-section is measured. The cross-section for π^+-mesons is separated off by assuming it equal to that for π^--mesons which was measured and described in the earlier article (Abstr. /1957). Measurements in the range 0.9-2.2 BeV are in good agreement with the results of others. In the region 1-5 BeV the proton cross-section changes slowly and is roughly equal to 0.75 geometrical. G.E.Brown

539.172.13 : 539.152.2

2636. THE ELASTIC SCATTERING OF PROTONS BY LIGHT ELEMENTS. G.Dearnaley.
Phil. Mag. (Eighth Ser.), Vol. 1, 821-34 (Sept., 1956).

The elastic scattering of protons by F^{19}, Be^9 and Na^{23} has been studied over a range of angles and energies between 0.5 and 2.6 MeV. The anomalies observed in the scattering cross-section curve at resonances excited in the compound nucleus have been analysed using dispersion theory. Resonance energies, widths and partial widths are deduced, and conclusions are given as to spins and parities of various states in Ne^{20}, B^{10} and Mg^{24} based on this and other evidence. A.

539.172.13 : 537.534.74

2637. SCATTERING OF PROTONS FROM C^{12}. C.W.Reich, G.C.Phillips and J.L.Russell,Jr.
Phys. Rev., Vol. 104, No. 1, 143-53 (Oct. 1, 1956).

The elastic scattering of protons from carbon in the range of bombarding energies 1.5 to 5.5 MeV has been investigated, using

protons from a Van de Graaff accelerator and a differentially pumped gas scattering chamber. Angular distributions and excitation curves at seven angles have allowed an explicit phase-shift analysis of the data below 5 MeV. Only five nonzero phase-shifts were necessary to fit the data to better than 10% at all energies and angles. The fourth and fifth excited states of N^{13} are identified at 4.808 and 5.37 MeV bombarding energy, and their respective assignments are $5/2^+$ and $3/2^+$, while their laboratory widths are 12 keV and 125 keV. The 4.43 MeV inelastic scattering γ-radiation was studied by obtaining excitation curves and angular distributions which confirmed the $3/2^+$ assignment for the 5.37 MeV resonance. The large ratio of inelastic to elastic reduced widths for this level suggests that it and possibly the fourth excited state of N^{13} are due to an S-wave proton configuration about C^{12} in its 2^+ first excited state. A.

539.172.13

2638. INELASTIC SCATTERING OF 96-MeV PROTONS. K.Strauch and F.Titus.
Phys. Rev., Vol. 104, No. 1, 191-8 (Oct. 1, 1956).

Using incident 96 MeV protons, the energy spectra of protons scattered into a laboratory angle of 40^0 have been obtained from the following elements: Li, Be, B, C, N, O, F, Na, Mg, Al, Si, P, S, Cu, Ag, Pb, and Bi. All targets had natural isotopic constitution. All spectra show an elastic peak and an inelastic continuum. Threshold considerations indicate that this continuum is often due to unresolved peaks at the very high-energy end. In addition the spectra from the lighter elements show large inelastic peaks corresponding to the direct excitation of nuclear states in the target nucleus. Systematic trends are discussed. A.

539.172.13

2639. 1.75-MeV RESONANCE IN $C^{13}(p,\gamma)N^{14}$. J.B.Marion and F.B.Hagedorn.
Phys. Rev., Vol. 104, No. 4, 1028-9 (Nov. 15, 1956).

The energy and width of the well-known 1.75 MeV resonance in this reaction have been investigated by bombarding a thick target of 60% C^{13} with electrostatically-analysed protons. The resonance energy was determined to be 1746.9 ± 0.8 keV, relative to the $Li^7(p,n)Be^7$ threshold at 1881.1 keV. The observed width was 510 eV. When account is taken of the thermal motion of the target atoms, an upper limit to the resonance width may be set at 400 eV; the contribution to this value of the spread in the beam energy is unknown. If one uses the radiation width previously measured by Seagrave ($\omega\Gamma_\gamma$ = 14.8 eV), the resonance cross-section is $\sigma_R > 64$ mb. The dimensionless reduced proton width (for d-waves) is $\theta_p^2 < 1.5 \times 10^{-3}$. A.

539.172.13

2640. (p,d) AND (p,α) REACTIONS IN Be^9. G.Weber, L.W.Davis and J.B.Marion.
Phys. Rev., Vol. 104, No. 5, 1307-13 (Dec. 1, 1956).

Excitation curves for the $Be^9(p,d)Be^8$ (ground state) reaction have been measured at observation angles of 15^0, 45^0, 70^0, 90^0, 110^0, and 135^0 for proton energies between 0.8 and 3.0 MeV. These curves show pronounced resonance structure and strong interference effects between different levels. About 60 angular distributions and the total cross-section curve were constructed from the 6 differential cross-section curves. The angular distributions are peaked forward, except in the region near 1.6 MeV, where a broad resonance, interfering with nonresonant amplitudes, causes the angular distribution to become almost symmetric about 90^0. The occurrence of forward peaking at all energies and the good agreement of the angular distribution at 2.84 MeV with a theoretical stripping curve suggest that a pickup process can account for a sizeable fraction of the reaction cross-section, even at energies as low as 1 MeV. The total cross-section indicates a resonance at 0.93 and weak maxima at 1.25, 1.65, and 2.3 MeV, but not at the T = 1 level at 2.56 MeV. The differential cross-section for the $Be^9(p,\alpha)Li^6$ (ground state) reaction was measured at 90^0 from 0.8 to 3.0 MeV. In addition to the 0.93 MeV peak, this curve shows a pronounced minimum near 1.4 MeV and a weak anomaly at 2.56 ± 0.02 MeV indicating a slight violation of the isotopic spin selection rule. An upper limit of 4×10^{-3} is obtained for the T = 0 impurity of the 2^+, T = 1 state at 8.89 MeV in B^{10}. A.

539.172.13

2641. STUDY OF THE $Li^6(p,\alpha)He^3$ REACTION. J.B.Marion, G.Weber and F.S.Mozer.
Phys. Rev., Vol. 104, No. 5, 1402-7 (Dec. 1, 1956).

This reaction has been studied in the energy range $0.6 \leq E_p \leq 2.9$ MeV by observing the magnetically analysed He^3 and α-particles at laboratory angles of 20^0 and 60^0. By inferring the α yield in the backward direction from the He^3 yield observed at the corresponding forward angle, it was possible to construct the angular distributions of the α-particles. Two resonances were found in the energy range studied, corresponding to a low-energy (≅ 1 MeV) s-wave state and a p-wave state near 1.85 MeV. A single-level resonance formula for a $J = 5/2^-$, p-wave state plus a smoothly varying background has been fitted to the total cross-section curve in the region of the 1.85 MeV resonance and the following resonance parameters extracted: E_λ = 2.20 MeV, Be^{7*} = 7.80 MeV, $\theta_p^2 = 0.24$, $\theta_\alpha^2 = 0.048$. A similar analysis was made of the data of Blair and Holland on the mirror reaction, $Li^6(n,\alpha)H^3$, and the following parameters obtained: E_λ = 0.43 MeV, Li^{7*} = 7.68 MeV, $\theta_n^2 = 0.26$, $\theta_\alpha^2 = 0.0085$. The close agreement between the reduced proton and neutron widths obtained from these mirror reactions indicates that the Be^7 level at 7.80 MeV and the Li^7 level at 7.68 MeV are mirror states with $J = 5/2^-$. This conclusion agrees with that previously reached by Bashkin and Richards. The α-particle angular distributions in the energy range $0.6 \leq E_p \leq 2.5$ MeV can be qualitatively explained on the basis of two interfering levels with $J = 3/2^+$ (at $E_p \cong 1.0$ MeV) and $J = 5/2^-$ (at $E_p \cong 1.85$ MeV). The angular distribution of the α-particles from the $Li^6(p,\alpha)He^3$ reaction at E_p = 2.91 MeV cannot be described in terms of s- and p-waves alone and suggests either that angular momenta greater than one are becoming effective in the formation of the compound nucleus at the higher bombarding energies or that a direct interaction process is taking place. A.

539.172.13

2642. NEUTRON POLARIZATION IN (p,n) REACTIONS AND NUCLEAR OPTICAL MODEL. J.Sawicki.
Phys. Rev., Vol. 104, No. 5, 1441-3 (Dec. 1, 1956).

The polarization of the neutron produced in a (p,n) reaction is calculated under the assumption of a direct mechanism for the reaction. The "cloudy crystal ball" potential modified by the spin–orbit coupling term is assumed to be the neutron–nucleus interaction. The model is applied to the reaction $Si^{29}(p,n)P^{29}$ for E_p = 6 and 6.5 MeV. The maximum negative polarizations ~ −75% come in for the centre-of-mass scattering angle $\theta \sim 75^0$. A.

539.172.13 : 532.74

CROSS-SECTION OF THE METHYL MERCAPTAN MOLECULE FOR THE SCATTERING OF SLOW NEUTRONS. See Abstr. 1958

539.172.13 : 539.166

GAMMA-RAYS FROM THE $Na^{23}(p,\gamma)Mg^{24+}$ REACTION. See Abstr. 2598

539.172.13

2643. NEUTRONS FROM THE PROTON BOMBARDMENT OF P^{31}. A.G.Rubin, G.D.Johnson and J.B.Reynolds.
Phys. Rev., Vol. 104, No. 5, 1444-5 (Dec. 1, 1956).

The reaction $P^{31}(p,n)S^{31}$ has been studied at E_p = 17.2 MeV. The energy spectrum of the neutrons was determined by means of proton recoil measurements in nuclear emulsions. The mass excess, M–A, of S^{31} was calculated to be −10.04 ± 0.20 MeV. Excited states of S^{31} have been located at 1.15 ± 0.15, 2.28 ± 0.20, 3.35 ± 0.20, 4.51 ± 0.15, 5.94 ± 0.30 and 6.41 ± 0.20 MeV. A.

539.172.13

2644. POLARIZATION OF 660 MeV PROTONS SCATTERED BY NUCLEI. M.G.Meshcheryakov, S.B.Nurushev and G.D.Stoletov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 361-70 (1956). In Russian.

Experiments on double scattering of 660 MeV (initial energy) protons are described. The angular dependence of the scattering asymmetry of 565 and 635 MeV polarized protons in beryllium was measured. The conjugated telescope method was used to determine the polarization in quasi-elastic (p–p) scattering at 635 MeV. Results of measurement of the scattering asymmetry of protons on carbon, aluminium, lead and bismuth at recording thresholds of 230 and 620 MeV and an angle of 9^0 are also presented. A.

539.172.13

2645. THE ANGULAR DISTRIBUTION OF NEUTRONS FROM HIGH ENERGY FISSION. G.N.Harding and F.J.M.Farley.
Proc. Phys. Soc. A, Vol. 69, Pt 11, 853-7 (Nov., 1956).

A measurement has been made of the ratio of the numbers of neutrons emitted in directions parallel and perpendicular to the motion of the fission fragments, when fission is induced in natural uranium by 147 MeV protons. The value obtained, 1.27 ± 0.11, is consistent with the greater part of the neutron emission occurring before fission, the remainder (2.5 ± 1 neutrons) being emitted from the moving fragments, as in thermal fission. A.

539.172.13

2646. CROSS-SECTION FOR FISSION OF URANIUM INDUCED BY HIGH ENERGY (140-660 MeV) PROTONS. N.S.Ivanova.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(9), 413-15 (1956). In Russian.

Nuclear emulsions were used to determine the fission cross-

section of U^{238} induced by 140, 350, 460 and 660 MeV protons. The probability of uranium fission for a given proton energy is estimated. A.

539.172.13

2647. FISSION OF URANIUM NUCLEI INDUCED BY HIGH-ENERGY PROTONS. N.S.Ivanova and I.I.P'yanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 416-23 (1956). In Russian.

Fission in uranium nuclei induced by high-energy protons and accompanied by emission of charged particles was investigated. The emitted particles were generated either in a nuclear cascade process or as a result of evaporation from the excited nucleus. A study of light particles appearing in photographic emulsions as a result of uranium fission induced by protons of various energies (from 140 to 660 MeV) was also carried out. The main characteristics of the selected group of ejected particles are compared with calculations performed by the Monte Carlo method for nuclear cascade processes induced in uranium nucley by 460 and 660 MeV protons. The agreement is found to be satisfactory. An estimate is made of the mean excitation energies of fissioned nuclei for incident proton energies of 140, 350, 460 and 660 MeV. A.

539.172.13

2648. AN INVESTIGATION OF NEUTRONS FROM THE REACTION $^{10}B(d,n)^{11}C$ AT 1.08 MeV BOMBARDING ENERGY. A.Graue.
Phil. Mag. (Eighth Ser.), Vol. 1, 1027-30 (Nov., 1956).

Angular distributions and energy spectra of the neutrons from the reaction $B^{10}(d,n)C^{11}$ have been measured at 1.08 MeV bombarding energy using the photographic plate technique. Energy levels were found in C^{11} at 2.02 ± 0.04, 4.24 ± 0.03 and 4.73 ± 0.03 MeV. A large part of the reaction cross-section must be due to compound nucleus formation. The experimental angular distributions can be adequately represented if a pure stripping curve is added to an isotropic distribution from compound nucleus formation. The orbital angular momentum of the captured protons has been determined. A.

539.172.13

2649. CROSS SECTIONS FOR THE $T(d,n)He^4$ REACTION. A.Galonsky and C.H.Johnson.
Phys. Rev., Vol. 104, No. 2, 421-5 (Oct. 15, 1956).

Differential cross-sections for the $T(d,n)He^4$ reaction have been measured as a function of energy at $\theta_n = 6^0$ (c.m.) from $E_d = 1.0$ to 5.0 MeV and as a function of angle at $E_d = 1.53$, 2.21, 3.05, 3.97, 4.98 and 5.79 MeV. The estimated uncertainties are within the range ±8% to ±11%. Although no sharp anomaly appears in the 6^0 excitation curve, there is a slow increase of ~ 50% from 2.5 to 5 MeV. In this energy region the total cross-section is flat or, perhaps, even slightly rising with increasing energy; whereas below 2.5 MeV it is a sharply decreasing function of energy. When compared with the much lower cross-section reported at $E_d = 10.5$ MeV, the present data may indicate a new level of He^5 with an excitation of ~ 22 MeV. The angular distributions, however, do not lend direct support to the resonance assumption since they are asymmetrical and contain large forward peaks. A.

539.172.13

2650. NUCLEAR EXCITATION FUNCTIONS AND THICK TARGET YIELDS: (Cr + d). P.Kafalas and J.W.Irvine,Jr.
Phys. Rev., Vol. 104, No. 3, 703-5 (Nov. 1, 1956).

Nuclear excitation functions and thick-target yields have been determined for several reactions which occur when chromium of natural isotopic composition is bombarded with deuterons of ~ 15 MeV. The reactions are $Cr^{52}(d,2n)Mn^{52}$, [$Cr^{53}(d,n)Mn^{54}$, $Cr^{54}(d,2n)Mn^{54}$], [$Cr^{50}(d,p)Cr^{51}$, $Cr^{50}(d,n)Mn^{51}\xrightarrow{\beta}Cr^{51}$, $Cr^{52}(d,t)Cr^{51}$], and $Cr^{50}(d,\alpha)V^{48}$. The excitation function for $Cr^{53}(d,n)$ was approximated by correcting for $Cr^{54}(d,2n)$ but the complex reactions yielding Cr^{51} could not be completely analysed. Stacked chromium foils were bombarded, Mn, Cr and V isolated chemically and the activities of relatively long-lived products measured with a calibrated scintillation counter. Absolute cross-sections were calculated for several of the reactions and thick target yields as a function of deuteron energy were calculated for the production of Mn^{52}, Mn^{54}, Cr^{51} and V^{48}. The energy loss of deuterons in chromium has been measured over the range of 3.8 to 13.6 MeV and some beam straggling data are presented. A.

539.172.13 : 539.172.4

2651. SCATTERING OF $D(d,n)He^3$ POLARIZED NEUTRONS BY C^{12}. B.M.McCormac, M.F.Steuer, C.D.Bond and F.L.Hereford.
Phys. Rev., Vol. 104, No. 3, 718-21 (Nov. 1, 1956).

The right–left asymmetry of $D(d,n)He^3$ neutrons scattered by C^{12} was observed for various neutron emission angles, deuteron bombarding energies and $C^{12}(n,n)$ scattering angles. Using a figure for carbon polarization based on a $C^{12}(n,n)$ phase-shift analysis, the maximum neutron polarization was found to be (10.6 ± 1.0)% for neutrons produced at 53^0 (c.m.) by 600-700 keV deuterons on a thick target. Observation of the right–left asymmetry for different neutron scattering angles yielded a sin 2θ angular dependence of the carbon polarization in agreement with the prediction of the $C^{12}(n,n)$ phase-shift analysis. A.

539.172.13 : 539.152.1

2652. ENERGY LEVELS OF Si^{28}. A.G.Rubin, F.Ajzenberg-Selove and H.Mark.
Phys. Rev., Vol. 104, No. 3, 727-30 (Nov. 1, 1956).

The neutron spectrum from the $Al^{27}(d,n)Si^{28}$ reaction has been investigated at eight angles by means of nuclear emulsions. The energy of the incident deuterons was 2.167 ± 0.015 MeV. The data indicate energy levels of Si^{28} at 1.78 ± 0.10, 4.54 ± 0.2, 4.95 ± 0.2, 6.24 ± 0.06, 6.88 ± 0.06, 7.39 ± 0.06, 7.89 ± 0.06, 8.31 ± 0.10, 8.57 ± 0.08, 9.37 ± 0.04, 10.00 ± 0.10 and 10.25 ± 0.06 MeV. A.

539.172.13

2653. DIFFERENTIAL CROSS SECTIONS FOR $C^{12}(d,d)C^{12}$ AND $C^{12}(d,p)C^{13}$. M.T.McEllistrem, K.W.Jones, R.Chiba, R.A.Douglas, D.F.Herring and E.A.Silverstein.
Phys. Rev., Vol. 104, No. 4, 1008-17 (Nov. 15, 1956).

Differential cross-sections have been measured as a function of incident deuteron energy for elastic scattering and for the (d,p) reactions to the ground and 3.09 MeV levels of C^{13}. The cross-sections have been measured at several angles from 25^0 (c.m.) to 169^0 (c.m.) in the deuteron energy range of 1.9 to 3.4 MeV and have an average accuracy of about 5%. Eleven angular distributions were also taken, nine for the reaction $C^{12}(d,p)C^{13}$ and two for the reaction $C^{12}(d,p)C^{13*}$. Many resonances were observed in the elastic scattering, and resonances observed in the (d,p) reactions corresponded to several of these. Interference between the stripping and compound nuclear contributions to the (d,p) reaction is clearly indicated. A.

539.172.13

2654. ELECTROSTATIC ANALYSIS OF NUCLEAR REACTION ENERGIES. R.A.Douglas, J.W.Broer, R.Chiba, D.F.Herring and E.A.Silverstein.
Phys. Rev., Vol. 104, No. 4, 1059-64 (Nov. 15, 1956).

Electrostatic analysis of incident and product particles has been used to measure the following reaction energies (in MeV): $D(d,H^3)p$ (4.044 ± 0.005); $D(d,He^3)n$ (3.271 ± 0.011); $C^{14}(d,\alpha)B^{12}$ (0.362 ± 0.002); $C^{14}(d,p)C^{15}$ (−1.007 ± 0.001); $B^{10}(\alpha,d)C^{12}$ (1.341 ± 0.002); $O^{16}(d,p)O^{17*}$, 0.87 level (1.048 ± 0.002); $N^{14}(d,p)N^{15*}$, 7.31 level (1.308 ± 0.002); 7.58 level (1.045 ± 0.002); 8.32 level (0.296 ± 0.001) and 8.57 level (0.038 ± 0.001); $C^{12}(d,p)C^{13*}$ 3.68 level (−0.960 ± 0.002) and 3.86 level (−1.130 ± 0.002) and $N^{14}(d,\alpha)C^{12*}$ 9.6 level (3.933 ± 0.014). The 30 keV width of the 9.6 MeV level of C^{12} limits the spin and parity assignment to 0^+, 1^-, 2^+ or 3^- or possibly 4^+. A.

539.172.13

2655. THE PROTON GAMMA ANGULAR CORRELATIONS IN THE $^{28}Si(d,p\gamma)^{29}Si$ STRIPPING REACTION. K.W.Allen, B.Collinge, B. Hird, B.C.Maglić and P.R.Orman.
Proc. Phys. Soc. A, Vol. 69, Pt 9, 705-12 (Sept., 1956).

The angular correlation between the protons and γ-rays from the reaction $Si^{28}(d,p\gamma)Si^{29}$ has been measured. Protons were selected which correspond to the excitation of the 1.28 MeV level in Si^{29}, the proton counter being set on the maximum of the stripping angular distribution at 30^0 to the deuteron beam direction. The angular correlation in the plane of scattering was found to be in agreement with the simple stripping hypothesis, but measurements in a plane perpendicular to the direction of the absorbed neutron, which according to the simple theory is an axis of symmetry, showed significant anisotropy. A.

539.172.3

2656. POLARIZATION OF NUCLEONS FROM PHOTONUCLEAR REACTIONS. W.Czyż and J.Sawicki.
Bull. Acad. Polon. Sci. Cl. 3, Vol. 4, No. 3, 141-5 (1956).

A method of calculating the degree of polarization is outlined, based on single-particle model wave-functions, and assuming a spin–orbit term in the photonucleon–residual nucleus interaction. Results for the $Be^9(\gamma,n)$ reaction, produced by 2 and 3 MeV γ-rays, are given. J.J.Wilkins

539.172.3

2657. ON THE PHOTODISINTEGRATION OF THE DEUTERON AND p–p SCATTERING. S.-H.Hsieh.
Nuovo Cimento (Ser. 10), Vol. 4, No. 1, 138-40 (July, 1956).

Amplification of the method used in a previously reported calculation (Abstr. 719/1957). P.T.Matthews

539.172.3

2658. CROSS SECTIONS FOR PHOTONEUTRON EMISSION INDUCED BY THE LITHIUM GAMMA RAYS. W.H.Hartley, W.E.Stephens and E.J.Winhold.
Phys. Rev., Vol. 104, No. 1, 178-82 (Oct. 1, 1956).

Cross-sections for emission of photoneutrons produced by $Li^7(p,\gamma)$ gamma-rays in thirteen middle-weight and heavy nuclei have been measured. Neutrons were detected by BF_3 counters embedded in paraffin, and the gamma-ray intensity was measured with a NaI scintillation detector. Measurements made with two groups of neutron counters whose efficiencies depended differently on neutron energy indicated that the energy distributions of the emitted neutrons are evaporation-like in shape. The present cross-section values are about 20% higher than previous measurements of McDaniel, Walker and Stearns, but the difference is within the combined errors. The measurements provide an independent check on the accuracy of the cross-section curves obtained with bremsstrahlung beams; agreement is obtained with University of Pennsylvania betatron data but not with some other betatron results. A.

539.172.3

2659. $C^{13}(\gamma,p)B^{12}$ CROSS SECTION. B.C.Cook, A.S.Penfold and V.L.Telegdi.
Phys. Rev., Vol. 104, No. 2, 554-5 (Oct. 15, 1956).

This has been measured to 38 MeV, and shows a broad peak of 8.8 mb near 25.5 MeV. The $C^{13}(\gamma,n)$ cross-section, also measured, shows an additional minor peak near 13.5 MeV. Combining the two cross-sections indicates that the total absorption cross-section for C^{13} has a broad peak of 3.7 mb at 13.5 MeV, followed by a broad "giant resonance" of 17.4 mb at 25.5 MeV. The integrated cross-section is similar to that for C^{12}, but the marked differences in detail are pointed out. J.J.Wilkins

539.172.3

2660. (γ,n) CROSS SECTIONS OF NUCLIDES NEAR NEUTRON NUMBER 50. P.F.Yergin and B.P.Fabricand.
Phys. Rev., Vol. 104, No. 5, 1334-9 (Dec. 1, 1956).

Measurement of the (γ,n) cross-sections of the nuclides Sr^{86}, Sr^{87}, Sr^{88}, Y^{89}, Zr^{92}, together with earlier measurements for the nuclides Zr^{90}, Zr^{91}, and Nb^{93} show a pronounced narrowing of the giant dipole resonances in the region of neutron number 50, the narrowest resonances being those for the 50-neutron nuclides. Possible confusion of the interpretation of the data due to $(\gamma,2n)$ and (γ,pn) processes is shown to be inadequate to explain the observed effects, and the narrowing is concluded to be real, in agreement with the prediction of the single-particle model of Wilkinson. The changes in widths are observed to occur entirely on the high-energy sides of the curves, the low-energy sides being remarkably similar for all 8 nuclides. A regularity in the behaviour of the peak values of the cross-sections is also observed. The (γ,n) threshold of Sr^{86} is observed to be at about 11.5 MeV, in agreement with other reaction data, but in disagreement with an earlier tentative assignment based on neutron yield measurements on natural Sr. A.

539.172.3

2661. PHOTONEUTRON YIELDS FROM NATURAL MAGNESIUM. P.F.Yergin.
Phys. Rev., Vol. 104, No. 5, 1340-2 (Dec. 1, 1956).

Published measurements of the cross-sections for the (γ,n) reaction in natural Mg and in Mg^{25} are in disagreement in the energy region where the other Mg isotopes do not contribute to the cross-section of the natural sample, and imply a most unusual cross-section curve for the Mg^{26} isotope at slightly higher energies. A new measurement of the cross-section for natural Mg is reported which disagrees strongly with the published data, but agrees with the Mg^{25} values, and implies a not-surprising cross-section curve for Mg^{26}. The origin of the disagreement in the natural-sample cross-section values is unknown. A.

539.172.3

2662. FINE STRUCTURE IN THE NUCLEAR PHOTOEFFECT. R.Wilson.
Phys. Rev., Vol. 104, No. 5, 1424-5 (Dec. 1, 1956).

It is shown that the widths of the levels presumed to be composing the giant resonance for photon absorption in carbon can be measured by self-absorption in carbon. Existing measurements suggest that the widths must be greater than 50 keV, in contradiction to other experiments. A.

539.172.3

2663. THE REACTIONS $^{12}C(\gamma,p)^{11}B$, $^{11}B(p,\gamma)^{12}C$ AND $^{12}C(\gamma,3\alpha)$ AT 17.63 MeV EXCITATION. A.K.Mann and E.W.Titterton.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 917-24 (Dec., 1956).

The absolute cross-section for the reaction $C^{12}(\gamma,p)B^{11}$ at 17.63 MeV has been determined from a measurement of the ratio of the number of protons to the number of "carbon stars" produced under the same experimental conditions, and utilization of the known cross-section for $C^{12}(\gamma,3\alpha)$. The value obtained is compared with that calculated by detailed balancing from data on the inverse reaction, $B^{11}(p,\gamma)C^{12}$, and shows that the measured values of the cross-sections for $C^{12}(\gamma,3\alpha)$ and $B^{11}(p,\gamma)C^{12}$ are consistent within their stated errors. A.

539.172.3

2664. POLARIZED NEUTRONS FROM THE REACTION D (γ,n). L.N.Rozentsveĭg.
Zh. éksper. teor. Fiz., Vol. 31, No. 1 (7), 166-7 (1956). In Russian.

This effect, which arises from the interference of electric and magnetic transitions, is evaluated for incident γ-ray energies of several MeV. G.E.Brown

539.172.3

2665. PHOTOPROTONS FROM A^{40}. A.P.Komar and I.P.Yavor.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 531 (1956). In Russian.

The angular distribution of protons from argon irradiated with γ-rays (maximum energy of 90 MeV) has been investigated with the help of an overcompression cloud chamber filled with argon. 302 tracks of protons have been considered. The distribution shows a pronounced maximum around 70°. The results show a dipole absorption of the γ-quantum in the argon nucleus. The asymmetry may be explained in terms of direct photoeffect or quadrupole absorption. G.Martelli

539.172.3

2666. INELASTIC SCATTERING OF PHOTONS ON In^{115} NUCLEI. O.V.Bogdankevich, L.E.Lazareva and F.A.Nikolaev.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 405-12 (1956). In Russian.

The yields of the reactions In^{115} (γ,γ') In^{115m} and In^{115} $(\gamma,2n)$ In^{113m} and the yield of neutrons accompanying photodisintegration of indium were measured at peak X-ray energies from 5 to 27 MeV. The cross-sections were calculated by the photon difference method. A.

539.172.4

2667. THE ELASTIC SCATTERING OF 136 MeV NEUTRONS BY NUCLEI. C.P.van Zyl, R.G.P.Voss and R.Wilson.
Phil. Mag. (Eighth Ser.), Vol. 1, 1003-12 (Nov., 1956).

The neutron elastic scattering cross-sections for lead, cadmium, copper, aluminium, oxygen, nitrogen, carbon, beryllium and lithium have been measured for an effective neutron energy of 136 MeV. A large liquid scintillator was used, and the cross-sections were obtained on an absolute scale. The integrated total elastic cross-sections are consistent with previous measurements of total and inelastic cross-sections. A.

539.172.4

2668. NEUTRON CROSS SECTION OF XENON-135. R.W.Deutsch.
Phys. Rev., Vol. 104, No. 2, 555 (Oct. 15, 1956).

Recent measurements of the total cross-section of Xe^{135} lead to two possible values for the absorption cross-section averaged over a 57°C Maxwellian neutron spectrum. These are $(2.19 \pm 0.09) \times 10^6$ barns and $(2.45 \pm 0.10) \times 10^6$ barns for J = 1 and J = 2 respectively. An analysis of recent work on the fission yield of Cs^{135} and Cs^{137} supports the conclusion that the angular momentum of the compound state is J = 2; with $Xe^{135} = (2.45 \pm 0.10) \times 10^6$ barns, other corresponding parameters are: $g = 5/8$, $E_0 = 0.0849 \pm 0.0010$ eV, $\Gamma_n^0 = 0.0182 \pm 0.0005$ eV, $\Gamma_\gamma = 0.0942 \pm 0.0032$ eV. D.R.Chick

539.172.4

2669. INTERACTION OF 0.5- AND 1.0-MeV NEUTRONS WITH SOME HEAVY ELEMENTS. R.C.Allen, R.B.Walton, R.B.Perkins, R.A.Olson and R.F.Taschek.
Phys. Rev., Vol. 104, No. 3, 731-5 (Nov. 1, 1956).

The angular distributions of 0.5 MeV neutrons elastically scattered by Au, Bi, U^{238}, U^{235} and Pu^{239} and of 1.0 MeV neutrons elastically scattered by the latter three materials have been measured. The differential and total elastic scattering cross-sections, the elastic transport cross-sections, and the inelastic collision cross-sections are presented. Some theoretical angular distributions and cross-sections based on a complex square-well model for U^{238} are also included. The angular distributions of fission neutrons produced by 0.5 and 1.0 MeV incident neutrons are found to be isotropic, and the ratio of $\bar{\nu}(Pu^{239})$ to $\bar{\nu}(U^{235})$ is 1.3 ± 0.2 at both energies. A.

539.172.4

2670. ANGULAR MOMENTUM ASSOCIATED WITH SLOW-NEUTRON RESONANCES. V.L.Sailor.
Phys. Rev., Vol. 104, No. 3, 736-9 (Nov. 1, 1956).

Available data on the statistical weight factor g for l = 0 neutron

resonances are summarized and the reliability of each result is discussed. There are reliable measurements for seventeen resonances which lie between 0 and 50 keV. In many cases, the results were obtained in two or more independent experiments. In sixteen cases, the compound nucleus has the spin $J = I + \frac{1}{2}$, while in only one case the spin is $J = I - \frac{1}{2}$. No data are available for weak resonances. Despite the limited data, it is strongly indicated that the compound nucleus is formed preferentially in the $I + \frac{1}{2}$ spin state. At present there is no basis for deciding whether this result arises from a difference in the level spacing D, or a difference in the average neutron width $\bar{\Gamma}_n^0$ for the two possible spin states. Regardless of the source of this effect it is apparent that the frequent assumption — that the strength function $\bar{\Gamma}_n^0/D$ is the same for the two spin states — may not be correct. A.

539.172.4

2671. NEUTRON CROSS SECTIONS OF ZINC. D.A.Dahlberg and L.M.Bollinger.
Phys. Rev., Vol. 104, No. 4, 1006-8 (Nov. 15, 1956).

The Argonne fast chopper was used in a study of neutron resonances in the zinc isotopes. The transmission of normal zinc and samples enriched in Zn^{64}, Zn^{66}, Zn^{67}, Zn^{68} and Zn^{70} were studied over the energy range 200 to 10 000 eV. Below 5 keV, seven resonances were observed, of which four are assigned to Zn^{67}, two to Zn^{64}, and one to Zn^{68}. The parameters σ_0 and Γ are calculated for these levels. A weighted average value of 0.35 is deduced for the radiation width Γ_γ. The strength function $\bar{\Gamma}_n^0/\bar{D}$ for Zn^{67} is found to be 3.1×10^{-4} $eV^{-1/2}$. A.

539.172.4

2672. FAST-NEUTRON CROSS SECTIONS OF Ge, As, Se, and Br. M.S.Zucker.
Phys. Rev., Vol. 104, No. 4, 1025-7 (Nov. 15, 1956).

The total cross-sections of Ge and Se were measured for neutron energies between 60 and 650 keV, and those of As and Br in the energy range from 60 to 3000 keV. A comparison with calculated values is made. A.

539.172.4

2673. TOTAL NEUTRON CROSS SECTION OF CHLORINE AND CARBON. R.N.Brugger, J.E.Evans, E.G.Joki and R.S.Shankland.
Phys. Rev., Vol. 104, No. 4, 1054-8 (Nov. 15, 1956).

This was measured with a crystal spectrometer (0.03 – 70 eV) and fast chopper (16–15 000 eV). The chlorine cross-section drops from 45 barns at 0.03 eV to a low of 1.3 barns at 5 keV. A sharp resonance is observed in Cl^{35} at 405 ± 6 eV. A two-sample-area analysis of this resonance gives the limiting values; $\Gamma < 0.6$ eV and $\sigma_0 > 580$ barns. For these limits $\Gamma_n = 0.14$ eV. Another level was observed at 8.7 ± 0.5 keV. A good fit to the cross-section data is given by a single-level Breit–Wigner formula for a negative-energy resonance in Cl^{35} with spin 2 and the following parameters; $E_0 = -140$ eV, $\Gamma_n^0 = 0.72$ eV, $\Gamma_\gamma = 0.48$ eV, $R = 4.74 \times 10^{-13}$ cm, and $\sigma_{pot} = 1.13$ barns. From these parameters, one would obtain $\sigma_{incoh} = 7.8 \pm 0.7$ barns and $\sigma_{act}(0.025\ eV) \approx 34.5 \pm 3.4$ barns. The carbon cross-section was also measured and appears flat with an average value of $\sigma_T = 4.69 \pm 0.10$ barns. A.

539.172.4

2674. SCATTERING OF 4.4-MeV NEUTRONS BY ALUMINUM, CALCIUM, CHROMIUM, AND BISMUTH. J.B.Weddell.
Phys. Rev., Vol. 104, No. 4, 1069-72 (Nov. 15, 1956).

The spectra of neutrons scattered for an incident neutron energy of 4.4 MeV have been measured by the proton-recoil nuclear plate technique. The energies of the levels excited by the (n,n'γ) process, given here, are obtained from previous measurements of the de-excitation gamma-ray energies while the cross-sections are based on the nuclear plate results alone. The results are: aluminium, scattering angle 82°: elastic, 46 ± 10 mb/sterad; unresolved inelastic levels at 0.84 and 1.01 MeV, 19 ± 7 mb/sterad; 2.23 MeV level, 15 ± 5 mb/sterad; 3.0 MeV level, 10 ± 5 mb/sterad; calcium at 82°: elastic, 49 ± 12 mb/sterad; inelastic—none; chromium at 90°: elastic, 37 ± 7 mb/sterad; 1.45 MeV level, 14 ± 5 mb/sterad; 2.43 MeV level (partially resolved), 5.0 ± 2.5 mb/sterad; 3.13 MeV level (partially resolved), 14 ± 7 mb/sterad; bismuth at 82°: elastic, 185 ± 40 mb/sterad; unresolved spectrum in energy range 0.9 MeV to 2.5 MeV, 135 ± 45 mb/sterad. A.

539.172.4

2675. INTERACTION OF 1.0-, 1.77-, 2.5-, 3.25-, AND 7.0-MeV NEUTRONS WITH NUCLEI. J.R.Beyster, M.Walt and E.W.Salmi.
Phys. Rev., Vol. 104, No. 5, 1319-31 (Dec. 1, 1956).

The differential cross-sections for elastic scattering of 2.5 MeV neutrons by Al, Fe, Zr, Sn, Ta, and Bi were measured over the angular range from 15° to 160°. At 7.0 MeV similar measurements were made for Be, C, Al, Fe, Zr, Sn, Ta, and Bi at angles ranging from 12° to 150°. Inelastic collision cross-sections were determined by sphere transmission measurements for a number of elements at 1.0, 1.77, 2.5, 3.25, and 7 MeV neutron energies. By using an optical model of the nucleus, cross-sections for elastic scattering and for compound nucleus formation were calculated. With suitable choices of the optical model parameters the calculated cross-sections are in reasonable agreement with the experimental values. A.

539.172.4

2676. SLOW-NEUTRON RESONANCE SCATTERING IN Ag, Au, AND Ta. R.E.Wood.
Phys. Rev., Vol. 104, No. 5, 1425-33 (Dec. 1, 1956).

Slow-neutron resonance scattering measurements by the "bright line" technique have been used as a supplement to and a check on total cross-section measurements. It has thus been possible to obtain a complete and consistent set of resonance parameters for the lowest energy resonances in Ag, Au and Ta. It was determined that the one-level formula is very well obeyed over wide energy ranges for both the scattering and total cross-section data. These resonance parameters are reported with the values for the statistical weight factor, g, of 3/4, 5/8, and 9/16 for Ag^{109}, Au^{197}, and Ta^{181} respectively. In addition it was determined that the nuclear radii are the same within experimental errors for the nonresonant and resonant spin states for Au and Ta. The results indicate that either the nuclear radii differ by 45% for the two spin states of Ag^{109} or the potential scattering of Ag^{107} is 55% larger than for Ag^{109}. A.

539.172.4

2677. TOTAL NEUTRON CROSS SECTIONS OF Be, C, F, Co, AND Ge. R.O.Bondelid, K.L.Dunning and F.L.Talbott.
Phys. Rev., Vol. 105, No. 1, 193-6 (Jan. 1, 1957).

Neutrons in the energy range 3.8 to 8.1 MeV were used to determine these cross-sections. Transmission measurements were made in steps of 100 keV with a neutron energy spread of 100 keV. The data are compared with previous results. A.

539.172.4

2678. THE ELASTIC SCATTERING OF NEUTRONS BY TRITONS AND ^{3}He. B.H.Bransden, H.H.Robertson and P.Swan.
Proc. Phys. Soc. A, Vol. 69, Pt 12, 877-87 (Dec., 1956).

Cross-sections and phase shifts for the elastic scattering of neutrons by tritons and He^3 are calculated over the energy range 1 to 14 MeV using central forces. Resonating group wave-functions are employed to derive integrodifferential equations for which accurate solutions are obtained with the aid of an electronic computer. The two-body interaction has exchange properties of either the Serber or the symmetrical type and a gaussian radial dependence with constants consistent with the binding energies of the alpha-particle and the deuteron. The calculated angular distributions are found to depend sensitively on the exchange nature of the interaction, although the available experimental data are insufficient to distinguish between the interactions considered. A.

539.172.4

2679. ON THE THEORETICAL DETERMINATION OF THE TOTAL REACTION CROSS-SECTION FOR NEUTRONS BY MEANS OF THE OPTICAL MODEL. P.Mittelstaedt.
Z. Naturforsch., Vol. 11a, No. 8, 663-76 (Aug., 1956). In German.

The neutron cross-sections at energies > 3 MeV have been calculated for heavy elements assuming a square-well optical potential $V = V_0(1 + i\zeta)$ with constant values of V_0 and ζ. Agreement with experiment is poor; it is improved by using a potential with a diffuse edge or by taking into account the variation of ζ with energy. The form of the function $\zeta(E)$ is estimated by considering the wavelength of the neutrons in the nucleus. Accurate calculations are carried out for Fe, Au, Pb in the energy range 1-14 MeV. D.J.A.Prowse

539.172.4 : 537.214

2680. DEFORMATION ENERGY OF A CHARGED DROP. II. SYMMETRIC SADDLE POINT SHAPES. W.J.Swiatecki.
Phys. Rev., Vol. 104, No. 4, 993-1005 (Nov. 15, 1956).

For Pt I see Abstr. 2425 (1956). Symmetric saddle point shapes and threshold energies of a uniformly charged drop are studied for values of the fissionability parameter x in the range 0.6 to 1.0. The method used is a modification of a conventional expansion about a prolate ellipsoid of revolution, which provides some control over the reliability of the approximations made. The electronic machine calculations of Frankel and Metropolis for x = 0.9, 0.81, 0.77, and 0.74 are consistent with the present work, but their result at x = 0.65 would appear to be in error. The calculations with an ellipsoid are preceded by a summary of formulae referring to expansions about a sphere. A.

ATOM AND MOLECULE BEAMS. MESONS. NEUTRONS 539.18

539.18

2681. POSSIBLE INTERFERENCE PHENOMENON BETWEEN PARITY DOUBLETS. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 104, No. 3, 822-7 (Nov. 1, 1956).

Possible interference phenomenon between parity doublets are discussed. In particular, the decay particle distributions of $\Sigma^{\pm}$ and Λ^0 produced in K^- + p capture and in π^- + p collision are analysed. These distributions may have interference terms with odd parity. Experimental detection of such terms would constitute an unambiguous proof of the existence of parity doublets. It is further pointed out that such interference terms have a rather interesting time dependence. A.

539.18

2682. DYNAMICAL THEORY OF K MESONS. J.Schwinger.
Phys. Rev., Vol. 104, No. 4, 1164-72 (Nov. 15, 1956).

Considerations leading to a complete dynamical theory of K-particles and hyperons are outlined. The theory exploits several points of analogy between the π field and the electromagnetic field, and gives a qualitatively satisfactory description of a number of phenomena. In particular, it accounts for the variety of K-particle decay modes, including those exhibiting opposite parity. A.

539.18

2683. OBSERVATION OF LONG-LIVED NEUTRAL V-PARTICLES. K.Lande, E.T.Booth, J.Impeduglia, L.M.Ledermann and W.Chinowsky.
Phys. Rev., Vol. 103, No. 6, 1901-3 (Sept. 15, 1956).

A search was made for long-lived neutral particles at the cosmotron. A 36 in. magnet cloud-chamber was exposed to the neutral radiation emitted from the Cu target at 68° to the 3 BeV proton beam. The 6 metre path length represented 100 Λ^0 mean lifetimes. Twenty-six V^0 events were observed all of which have anomalous Q-values for two-pion decay. No secondary can be a proton and all but three have mass less than the K-meson. Various $\pi\mu\nu$ combinations are possible; analysis of information from the charged secondaries indicates that the average primary mass is about 500 MeV and that the mode $\pi\nu$ is the most frequent. Making use of the roughly known cross-section for K^0 production, a mean lifetime is obtained in the range 10^{-6} sec $> \tau > 3 \times 10^{-9}$ sec. The observed uniform distribution of events sets a lower limit 10^{-9} sec. Before identifying the anomalous long-lived V^0 with the θ_2^0 of Gell-Mann and Pais (See Abstr. 4088/1955) evidence must be obtained about its nuclear interaction properties. R.H.W.Johnston

539.18

2684. EVIDENCE FOR A LONG-LIVED NEUTRAL UNSTABLE PARTICLE. W.F.Fry, J.Schneps and M.S.Swami.
Phys. Rev., Vol. 103, No. 6, 1904 (Sept. 15, 1956).

In the course of a scan of emulsion exposed to the Bevatron 90° 280 MeV/c momentum K^- beam, four events were found which involve the apparent production of a single strange particle in a low-energy interaction. They are interpreted as due to interactions of long-lived neutral K-particles produced in the target with frequency comparable to that of K^+-meson production. "Ordinary" θ^0 particles would have had to live about 20 mean lifetimes. Energetic neutron stars are rare in the stack. R.H.W.Johnston

539.18

2685. MULTIPLE PRODUCTION OF STRANGE PARTICLES. Tsai-Chü and M.Morand.
Phys. Rev., Vol. 104, No. 5, 1493 (Dec. 1, 1956).

An event involving at least three strange particles coming from a star of the type 14 + 5p has been observed in the Sardinia stack S36; they are identified as a hyperon Σ^- captured at the end of its trajectory, a hyperon Σ^+ decaying in flight, and a negative K meson interacting in flight. It is suggested that the event could be understood if the negative hyperon had strangeness +1 (antihyperon). E.W.Kellermann

539.18 : 539.166.2

STRANGE PARTICLES PRODUCED BY PROTON BOMBARDMENT AT BeV ENERGIES. See Abstr. 2608

539.18

2686. NUCLEAR DISINTEGRATION OF A HEAVY MESON. Yu.G.Degtyarev, A.P.Zhdanov and P.I.Lukirskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 5, 843-4 (1954). In Russian.

A cosmic ray event in emulsion is described which appears to represent the elastic collision with a proton of a heavy meson (1220 ± 175 m_e) near the end of its range. After traversing a further 40 μ the meson comes to rest and gives rise to a small nuclear disintegration. W.O.Lock

539.18

2687. NONMESONIC DECAY OF A He^4 HYPERFRAGMENT. A.G.Barkow and B.Chamany.
Phys. Rev., Vol. 105, No. 2, 692-3 (Jan. 15, 1957).

A He^4 hyperfragment was observed in a cosmic-ray star. The disintegration is nonmesonic and results in the collinear production of a triton and proton. The binding of the Λ^0 particle was measured and found to be 4.3 ± 1.6 MeV. A.

539.18

2688. ON THE PROBABILITY OF DECAY OF A Σ-PARTICLE. L.B.Okun'.
Zh.éksper. teor. Fiz., Vol. 31, No. 2(8), 333-5 (1956). In Russian.

Restrictions upon the branching ratios of the different decay modes of $\Sigma^{\pm}$-particles are derived from the invariance properties of the transition matrix. W.O.Lock

539.18

2689. THEORY OF THE π-MESON DECAY. A.A.Vedenov.
Zh. eksper. teor. Fiz., Vol. 31, No. 2(8), 347-8 (1956). In Russian.

The probability of the process $\pi \rightarrow \mu + \gamma + \nu$ is calculated in perturbation theory, assuming that the μ-meson has an anomalous moment. G.E.Brown

539.18

2690. CORRELATED PHENOMENA IN THE CAPTURE OF K-MESONS. V.B.Berestetskiĭ and I.Ya.Pomeranchuk.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 350-1 (1956). In Russian.

In the process $K^- + p \rightarrow \Lambda^0 + \pi^0 \rightarrow p + \pi^- + \pi^0$ the angular distribution between the relative momenta of the systems (Λ,π^0) and (p,π^-) can give information about the Λ-spin, assuming K^- to be captured in an s-state. The angular correlation in the presence of an external magnetic field is also discussed. G.E.Brown

539.18

2691. PION AND MUON MASSES. E.R.Cohen, K.M.Crowe and J.W.M.DuMond.
Phys. Rev., Vol. 104, No. 1, 266-7 (Oct. 1, 1956).

It is pointed out that if one assumes that the masses of the positive and negative pions are identical, the mass difference combined with the mesonic X-ray limits gives a much narrower limit on the pion and muon masses than heretofore available, yielding $M_\pi = (273.25 \pm 0.12)\ m_e$ and $M_\mu = (206.84 \pm 0.16)\ m_e$. E.W.Kellermann

539.18

2692. MASS DIFFERENCE BETWEEN THE Σ^+ AND Σ^- HYPERONS AND THE MASS OF THE K^- MESON. W.F.Fry, J.Schneps, G.A.Snow, M.S.Swami and D.C.Wold.
Phys. Rev., Vol. 104, No. 1, 270-1 (Oct. 1, 1956).

Amongst 900 K^- stars in emulsion two events have been interpreted as the capture of K^- mesons at rest by hydrogen, one producing a Σ^+ hyperon, the other a Σ^- hyperon. Their mass difference is determined as (15.9 ± 2.9) m_e. E.W Kellermann

539.18

2693. MASS DIFFERENCE OF $\Sigma^{\pm}$ AND THEIR ANOMALOUS MAGNETIC MOMENTS. E.C.G.Sudarshan and R.E.Marshak.
Phys. Rev., Vol. 104, No. 1, 267-9 (Oct. 1, 1956).

The mass differences have been calculated in terms of electromagnetic self-energies, assuming the Σ to be a Dirac particle. It is concluded that the observed sign of the mass difference of $\Sigma^{\pm}$ is an argument for the presence of strong scalar coupling of the K meson to the baryons. E.W.Kellermann

539.18 : 778.34

DETERMINATIONS OF K-PARTICLE MASSES. See Abstr. 1831

539.18

2694. ON THE DETERMINATION OF THE SPINS OF K-PARTICLES AND HYPERONS. L.I.Lapidus.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 342-3 (1956). In Russian.

Several absorptive nuclear reactions for K-particles of the type discussed by Lee (Abstr. 9964/1955) are suggested for the determination of K-particle and hyperon spins by detailed balancing experiments. W.O.Lock

539.18

2695. CAUSALITY AND DISPERSION RELATIONS FOR THE SCATTERING OF MESONS BY FIXED NUCLEONS. R.Oehme.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1316-28 (Dec., 1956).

The derivation of dispersion relations for meson–nucleon scattering is re-examined. So far, all proofs given require the assumption that the Fourier representation of the scattering amplitude exists in the unphysical energy region. In this note it is shown that in the limit of fixed nucleons the causality conditions and the properties of the spectrum are already sufficient to derive dispersion formulae for the forward scattering amplitudes. With the same assumptions one can also derive dispersion relations for the derivative amplitudes. The complete relativistic case is discussed briefly in the appendix. A.

539.18

2696. SCATTERING AND ABSORPTION OF π^+ MESONS IN LEAD. G.Saphir.
Phys. Rev., Vol. 104, No. 2, 535-41 (Oct. 15, 1956).

The interactions of 50 ± 15 MeV π^+-mesons in lead were investigated by means of a magnet cloud chamber containing a single $\frac{1}{8}$ in. lead plate. The following cross-sections were found: for elastic scattering greater than 40^0, 252 ± 36 millibarns; for star production, 852 ± 82 millibarns; for charge-exchange scattering, 27 ± 19 millibarns. Only one of the 52 observed scatters was inelastic. The elastic scattering has a minimum near 90^0. The mean free path of π^+-mesons in nuclear matter, derived from the inelastic events and large-angle scatters in this experiment, is $(9.0 \pm 1.5) \times 10^{-13}$ cm. The results are compared with information from related experiments. A.

539.18

2697. SCATTERING OF K^+ PARTICLES. M.Widgoff, A.M.Shapiro, R.Schluter, D.M.Ritson, A.Pevsner and V.P.Henri.
Phys. Rev., Vol. 104, No. 3, 811-15 (Nov. 1, 1956).

An experiment has been performed to investigate the relative probability of scattering of K_{π_2} and τ mesons. If, as is thought on the basis of the analysis of Dalitz and others, these particles differ in spin-parity properties, they may be expected to have different scattering cross-sections, and the relative proportions of τ and K_{π_2} mesons in a beam of scattered K-particles would differ from their relative proportions in a beam of directly-produced particles. In the present experiment, a measurement was made of the composition of a K^+-particle beam in which it is estimated that more than $\sim 75\%$ of the particles had undergone scattering. Comparison with other results on the composition of beams consisting predominantly of directly-produced particles indicates that the relative numbers of τ and K_{π_2} mesons are unchanged, within $\sim 30\%$. The results are therefore consistent with the assumption that the τ and K_{π_2} are the same particle. A.

539.18

2698. PION–NUCLEON COUPLING CONSTANT AND SCATTERING PHASE SHIFTS. U.Haber-Schaim.
Phys. Rev., Vol. 104, No. 4, 1113-15 (Nov. 15, 1956).

Goldberger's relations for the forward scattering of pions are used in the following way. Two linear functions of ν^2, where ν is the total pion energy in the laboratory system, are constructed from quantities taken from experiment, i.e., forward amplitudes and integrals over total cross-sections. The extrapolation of one of these functions to $\nu = 0$ gives $2f^2$, where f is the renormalized pion–nucleon coupling constant. Various sets of phase shifts are compared as to their compatibility with the above functions. A.

539.18

2699. COMPARISON OF SPIN–FLIP DISPERSION RELATIONS WITH PION–NUCLEON SCATTERING DATA. W.C.Davidon and M.L.Goldberger.
Phys. Rev., Vol. 104, No. 4, 1119-21 (Nov. 15, 1956).

The dispersion relations for the spin–flip, forward-scattering amplitude have been tested against pion–nucleon scattering data for energies up to 300 MeV. The Fermi set of phase shifts satisfy these relations while the Yang set do not. An approximate value for the renormalized coupling constant, $f^2 = (g\mu/2M)^2$, of 0.1 is obtained from the P-wave phase shifts. A

539.18

2700. SCATTERING OF π^+-MESONS ON HYDROGEN. I. ANGULAR DISTRIBUTION AT ENERGIES OF 176, 200, 240, 270 AND 307 MeV. A.I.Mukhin, E.B.Ozerov and B.Pontekorvo (Pontecorvo).
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 371-85 (1956). In Russian.

Scintillation counters were used to study the angular distribution of 176, 200, 240, 270 and 307 MeV π^+-mesons scattered in hydrogen. The total interaction cross-sections for π^+-mesons in hydrogen were also measured, the flux attenuation method being applied for this purpose. At all indicated energies excepting 307 MeV the data can be satisfactorily described by a function of the type $d\sigma/d\Omega = a + b \cos\theta + c \cos^2\theta$. A.

539.18

2701. SCATTERING OF π^+-MESONS ON HYDROGEN. II. DISCUSSION AND INTERPRETATION OF THE RESULTS. A.I.Mukhin and B.Pontekorvo (Pontecorvo).
Zh. éksper. teor. Fiz., Vol. 31, No. 4 (10), 550-9 (1956). In Russian.

For Pt I see preceding abstract. Phase-shift analysis of the data on scattering of π^+-mesons on hydrogen at various energies up to 307 MeV is presented. The analysis was performed with an electronic computer on the assumption that the scattering process can be satisfactorily described by only S and P waves (S–P analysis) and also on the assumption that five parameters are required to describe the scattering process (S–P–D analysis). The energy dependence of the various phase shifts obtained by the S–P and S–P–D analyses is shown graphically. The measurements indicate that the meson-nucleon interaction radius is approximately 7×10^{-14} cm. A.

539.18

2702. HIGH-ENERGY PHENOMENA IN NUCLEAR EMULSIONS. J.E.Naugle and P.S.Freier.
Phys. Rev., Vol. 104, No. 3, 804-11 (Nov. 1, 1956).

Three interactions occurring in nuclear emulsions and caused by primaries of charge ≥ 2 and energy $> 10^4$ BeV/nucleon are described. The electromagnetic cascade from one of these showers has been studied in detail. The mean free path for direct pair production (trident) has been measured in various intervals. The mean free path for direct pair production (trident) has been measured in various intervals. The mean free path at energies <10 BeV is shorter than the theoretical one calculated by Racah, but the small number of cases (7) at these energies allows large fluctuations. For the mean free path of the high-energy electrons whose energies measured by scattering have a lower limit of 6 BeV placed on them, a significant disagreement is found with theory only if the average electron energy is as low as 10 BeV. The average electron energy is shown to be more like 50-100 BeV, thus giving no disagreement with the theoretical cross-section for direct pair production. A.

539.18

2703. ANGULAR DISTRIBUTION OF π-MESONS PRODUCED BY POLARIZED NUCLEONS. V.B.Berestetskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, 421-3 (1954). In Russian.

A formula for the asymmetry in the mesons is derived for low energies, such that production in only the S and P states need be considered. The processes are: $p + p \rightarrow \pi^+ + d$, and $n + p \rightarrow \pi^0 + d$. G.E.Brown

539.18

2704. ON THE HYDRODYNAMICAL MODEL IN MULTIPLE PRODUCTION OF MESONS. M.Hanaguchi.
Nuovo Cimento (Ser. 10), Vol. 4, No. 6, 1242-61 (Dec., 1956).

The viscous stress tensors in the relativistic covariant form are introduced in the description of multiple production of the particles in high-energy collisions. The effects of viscosity are calculated in first-order approximation and also the qualitative differences from Landau's theory are discussed on the basis of the concept of irreversibility in relativistic thermodynamics. A.

539.18

2705. ASSOCIATED PRODUCTION OF HYPERONS AND K MESONS S.Barshay.
Phys. Rev., Vol. 104, No. 3, 853-5 (Nov. 1, 1956).

Suggestions are made for a possible interpretation, in terms of a coupling between pions and K-mesons and a coupling between pions and hyperons, of observed asymmetries in the angular distribution of Λ^0 and K^0 particles produced in association in pion–nucleon and in nucleon–nucleon collisions and of Σ^- and K^+ particles produced in pion–nucleon collisions. E.W.Kellermann

539.18

2706. MESON PRODUCTION IN DEUTERIUM BY 1.4-BeV PIONS. V.P.Kenney.
Phys. Rev., Vol. 104, No. 3, 784-94 (Nov. 1, 1956).

Pion–nucleon interactions have been produced in a deuterium-filled diffusion cloud-chamber operated in the 1.37 BeV π^- beam at the Cosmotron in order to compare the characteristics of π^-–n and π^-–p collisions. A total of 180 interactions have been observed and analysed, and the total cross-section for π^-–d collisions is esti-

mated to be 72 ± 15 millibarns. The results are consistent with approximately equal π^-—p and π^-—n cross-sections and a ratio of elastic : inelastic events = 1 : 2 for both types of interaction. Approximately 15% of the inelastic collisions are cases in which two or more mesons are produced. Analysis of distributions of angles, momenta, and charges suggests a process for meson production in which the statistical model is slightly modified by a specific meson—nucleon interaction. The observed ratio of π^-—n charge states $(n\pi^-\pi^0) : (p\pi^-\pi^-) = (1.8 \pm 0.6) : 1$ indicates that interactions proceeding through the isotopic spin $T = \frac{3}{2}$ do not predominate. The prominence of $(p\pi^-\pi^-)$ and $(p\pi^-\pi^0)$ charge states together with a lack of correlation between emitted pion directions suggests that neither T = 0 nor T = 1 π—π resonances play a significant role at this energy. A.

539.18

2707. MESON PRODUCTION BY MESONS IN THE TAMM—DANCOFF APPROXIMATION. M.Nelkin.
Phys. Rev., Vol. 104, No. 4, 1150-64 (Nov. 15, 1956).

The cross-section for the production of a single additional meson in meson—nucleon collisions is calculated. The charge-symmetric pseudoscalar interaction is used in Tamm—Dancoff approximation, neglecting the amplitudes of all states containing more than two mesons. The results are presented by giving the ratio of production to scattering cross-section as a function of the energy, angular momentum, parity, and isotopic spin of the incident state. This ratio can be obtained either by direct calculation of the production matrix element, or by calculation of the reactive effects on meson–nucleon scattering. It is explicitly shown that these two methods give identical results in the physical approximation employed. An estimate is made of the production cross-section very near threshold, and numerical results are presented for incident meson energies up to 1.4 BeV. The experimental information that is available indicates that the ratio of production to scattering is considerably greater than has been calculated here. This discrepancy is probably due to the omission of final state scattering through three-meson intermediate states. A.

539.18 : 537.534.74

2708. FORMATION OF π^+-MESONS IN 660 MeV (p—p) COLLISIONS. V.M.Sidorov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 178-87 (1956). In Russian.

The energy spectrum of π^+-mesons from the $p + p \rightarrow \pi^+ + \begin{cases} d \\ pn \end{cases}$ reaction at an energy of 657 ± 8 MeV was measured with the aid of nuclear emulsions for angles $\theta_\pi = 60^\circ$, 75°, 90°, 105° and 120° in the laboratory system. The angular dependence of the cross-sections $d\sigma/d\omega$ in the centre-of-mass system of the colliding nucleons and also the total cross-sections for the reactions $pp \rightarrow \pi^+ + \begin{cases} d \\ pn \end{cases}$, $pp \rightarrow d\,\pi^+$ and $pp \rightarrow pn\pi^+$ were determined. The results agree with the assumption that the mesons are mainly produced in the p-state. In addition to transitions to the S-state of the final n—p system, transitions in which the final nucleons are produced in the P-state, also give an appreciable contribution. A.

539.18

2709. THEOREM ON THE EQUALITY OF THE PHOTOPRODUCTION CROSS-SECTIONS OF CHARGED π-MESONS IN NUCLEI WITH ZERO ISOTOPIC SPIN. V.L.Pokrovskiĭ.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 537-8 (1956). In Russian.

From symmetry arguments it is shown that $d\sigma(\pi^+) = d\sigma(\pi^-)$. G.E.Brown

539.18

2710. PRODUCTION OF POSITIVE π-MESONS BY 660 MeV PROTONS [SCATTERED] ON HYDROGEN. A.G.Meshkovskiĭ, Yu.S.Pligin, Ya.Ya.Shalamov and V.A.Shebanov.
Zh. éksper. teor. Fiz., Vol. 31, No. 4(10), 560-4 (1956). In Russian.

The energy spectrum for charged π-meson production in the $p + p \rightarrow \pi^+$ reaction has been obtained for angles of 29° and 46° with respect to the proton beam. The differential cross-sections for angles 29°, 46° and 65° in the laboratory system have been measured. A.

539.18 : 539.163.2

π^--MESON PRODUCTION IN Li^{7*} DECAY. See Abstr. 2581

539.18 : 539.172

MESON PRODUCTION IN HIGH-ENERGY NUCLEAR COLLISIONS. See Abstr. 2619

539.181

2711. VELOCITY ANALYSIS OF LAVAL RAYS. E.W.Becker and W.Henkes.
Z. Phys., Vol. 146, No. 3, 320-32 (1956). In German.

The velocity distribution of molecular beams from a "Laval nozzle", previously described (Abstr. 2217/1955), is investigated using a time-of-flight technique. The beam is chopped by a rotating disk, and detected by a triode ionization gauge. The injection nozzle could be cooled by liquid hydrogen. Results were obtained for argon and hydrogen, as well as for mixtures of the two. Comparison with beams from a conventional "oven" source show velocity distributions with considerably higher expectation values and lower widths. For a 20% A + 80% H_2 mixture, an almost pure beam of argon, with an expectation velocity of 1240 m/sec and a half intensity width of 260 m/sec could be obtained. E.A.Ash

539.181

2712. BEAMS OF CONDENSED ATOMS AND MOLECULES IN A HIGH VACUUM. E.W.Becker, K.Bier and W.Henkes.
Z. Phys., Vol. 146, No. 3, 333-8 (1956). In German.

Under suitable conditions of temperature and pressure, the production of a molecular beam using a "Laval nozzle" (see preceding abstract), can result in the partial condensation of the gas in the nozzle. Measurement of the velocity distribution and the beam intensity reveals that this phenomenon is accompanied by a marked increase in velocity and intensity, and a decrease in the width of the velocity distribution. The effect has been demonstrated for hydrogen, argon and nitrogen. An argon beam, produced in this way, with a half-intensity velocity-distribution width of less than 5% has been observed. E.A.Ash

539.185.08

2713. HIGH TRANSMISSION MECHANICAL NEUTRON-MONOCHROMATOR FOR FILTERING OF HIGHER ORDER REFLECTIONS. N.Holt.
Rev. sci. Instrum., Vol. 28, No. 1, 1-3 (Jan., 1957).

The construction of a mechanical monochromator for the cold neutron region with 80% transmission is described. The apparatus is specially designed to be used in connection with a neutron crystal spectrometer for filtering out higher order reflections by placing it between the crystal and the counter. An experimental test of the machine has been performed by measuring the gold cross-section and the neutron intensity as a function of the angular velocity of the rotor for a certain wavelength. The result shows that no higher order neutrons are transmitted. A.

539.185

2714. MEASUREMENT OF THE SOURCE-STRENGTHS OF A Be-PHOTO- AND OF A Ra-Be-NEUTRON SOURCE. C.von Planta and P.Huber.
Helv. phys. Acta, Vol. 29, No. 4, 375-400 (1956). In German.

The neutron density in a water moderator surrounding the source is measured using Au foil as detector. Comparisons are made with earlier measurements. A.O.Stanesby

539.185 : 548.74

2715. INELASTIC SCATTERING OF LOW-ENERGY NEUTRONS BY LATTICE VIBRATIONS OF VANADIUM. R.S.Carter, D.J.Hughes and H.Palevsky.
Phys. Rev., Vol. 104, No. 1, 271-2 (Oct. 1, 1956).

Pile neutrons were filtered through Be to give a mean wavelength of 4.5 A, and were scattered by V, for which almost all of the scattering is incoherent. The frequency distribution of the normal modes of vibration was deduced from the results obtained. This did not agree with the distribution to be expected on a simple Debye model nor with that on a modified model, although the discrepancy was reduced in the latter case. The resolution is not sufficient to permit the details of the distribution to be observed, so that it was not possible to test Van Hove's prediction that discontinuities and cusps would occur at certain critical frequencies. However, improvements now in hand should permit such a test. J.Thewlis

539.185

2716. COMPOUND ELASTIC SCATTERING OF NEUTRONS. W.S.Emmerich and R.M.Sinclair.
Phys. Rev., Vol. 104, No. 5, 1399-401 (Dec. 1, 1956).

The complex potential model predicts a division of the average neutron elastic scattering cross-section into shape and compound scattering. The normalized differential elastic cross-sections calculated from this model are expanded in a series of Legendre polynomials and compared with data derived from experiments, demonstrating the presence of compound elastic scattering. A.

539.185

2717. ELASTIC SCATTERING OF 580 MeV NEUTRONS BY PROTONS. Yu.M.Kazarinov and Yu.H.Simonov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 169-73 (1956). In Russian.

The differential cross-section for elastic scattering of 580 MeV neutrons by protons was measured in the angle range from $\theta = 35^0$ to $\theta = 180^0$ (in the centre-of-mass system) with an angular resolution of 2^0. The dependence $\sigma_{np}(\theta)$ thus obtained indicates that at an energy of ~ 600 MeV the interaction in the n–p system can be appreciable in states with orbital moments up to $l \cong 6$. The results are consistent with the charge-independence hypothesis. A.

539.185

2718. ELASTIC SCATTERING OF 590 MeV NEUTRONS BY NEUTRONS. B.M.Golovin and V.P.Dzhelepov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 194-201 (1956). In Russian.

The neutron-telescope method was used to determine the differential cross-sections for the scattering of 590 MeV effective energy neutrons by neutrons. A pronounced anisotropy in the n–n scattering was found: $\sigma_{nn}(30^0)/\sigma_{nn}(90^0) = 2.3$. Within the experimental errors the differential cross-section for n–n scattering in the investigated angular range, $30^0 \leq \theta \leq 90^0$, was found to be equal to the p–p scattering cross-section for the same energy. This fact and also the results previously obtained on n–n scattering at 300 MeV confirm directly the charge symmetry of nuclear forces in the high-energy region. A.

539.185

2719. THE NEUTRINO. F.Reines and C.L.Cowan,Jr.
Nature (London), Vol. 178, 446-9 (Sept. 1, 1956).

A review of the properties of the neutrino including the results of some important new experiments by the authors. Using a very large scintillation counter near a fission reactor an upper limit of 10^{-9} Bohr electron magnetons has been placed on the magnetic moment. The non-identity of the neutrino and antineutrino has again been demonstrated by measurement of the lifetime of Nd^{150} A lower limit of 4×10^{18} years was obtained which is to be compared with 1.3×10^{15} years expected if the neutrinos are identical as proposed by Majorana and Furry. The reaction $\nu_- + p^+ \rightarrow \beta^+ + {}^0n$ had been investigated previously using the neutrino flux from a large reactor, the target protons being supplied by a large liquid scintillator; the reaction was observed to take place but the signal/noise ratio was very small. A new experiment has been performed in which the positron annihilation pulses are detected by two scintillators in coincidence, the γ-rays following the capture of the slow neutron by cadmium in the target are detected in coincidence several microseconds later. A counting rate of 3 per hour was observed which gives a cross-section of about 6×10^{-44} cm^2 which is in agreement with that predicted. A discussion of the neutrino–deuteron reaction shows interesting possibilities: a possible direct measurement of the ratio of the Gamov–Teller and Fermi coupling constants in β-decay; the existence of a bi-neutron might also be detected if such a particle exists in a bound state. D.J.A.Prowse

STRUCTURE OF SOLIDS 539.2

539.21

2720. THE EFFECT OF NEUTRON IRRADIATION ON THE PROPERTIES OF SOLID BODIES. H.H.Hausner.
Schweiz. Arch. angew. Wiss. Tech., Vol. 22, No. 9, 273-81 (Sept., 1956). In German.

Explains on which variables this phenomenon depends and which properties of the reactor materials are changed by neutron irradiation. The change of strength, hardness, impact strength, electrical conductivity and density is illustrated by examples. The state of the material at the beginning of the exposure, as well as the temperature during exposure, influence the changes strongly. The processes which happen in the crystal lattice during exposure are shortly explained. Then the most important reactor materials such as uranium, aluminium, graphite, ceramics and organic compounds are discussed and the influence of alpha-radiation on metals and other radiations on glasses mentioned. The drastic changes of uranium (for instance the instability of shape and volume) can be prevented by special metallurgical processes. A.

539.21 : 548.7 : 537.531.9

U.V. AND X-RAY IRRADIATION EFFECTS IN GLASS, SILICA AND QUARTZ. See Abstr. 2288

539.21 : 539.434

CREEP OF ALPHA-URANIUM DURING IRRADIATION WITH NEUTRONS. See Abstr. 2755.

539.213.1

2721. RELAXATION PROCESSES IN GLASS. P.L.Kirby.
Trans Faraday Soc., Vol. 52, Pt 1, 131-42 (Jan., 1956).

An interpretation of the relaxation effects of retarded elastic and internal friction processes in an inorganic glass is given in terms of rate process equations, and the results are used to determine the distribution of relaxation times. These relaxation spectra are determined at several temperatures for the viscoelastic relaxation of the vitreous network and for the differential relaxation of alkali ions. Resulting implications concerning variations in activation energies and entropies are discusses in terms of the theory of the random structure of the vitreous state. A.

539.215

2722. PARAMAGNETIC RESONANCE IN CHARCOALS. SURFACE EFFECTS. J.Uebersfeld and E.Erb.
J. Phys. Radium, Vol. 17, No. 5, 452-3 (May, 1956). In French.

The paramagnetic resonance of charcoal obtained by pyrolysing saccharose increases with decrease of particle size both in the presence and in the absence of air. The bulk density of radicals is of the order of 10^{18} per gramme and the surface layer of thickness $> 0.05\,\mu$ has a higher radical density. D.H.Whiffen

539.215.08 : 531.52

2723. SEPARATION OF PARTICULATE MATERIALS INTO SIZE-RANGES. H.E.Rose and R.N.Langmaid.
Nature (London), Vol. 178, 485 (Sept. 1, 1956).

Glass spheres, diameters 0.02-0.06 in., were allowed to fall from a funnel into a polythene beaker, dia. 3 in. and height $3\frac{1}{4}$ in., the height of fall being 12 in. The beaker stood inside a larger, 1 litre capacity, beaker which acted as receptacle for the separated fraction of spheres which escaped over the edge of the smaller beaker after rebounding from the layer of material inside. The size–distribution curves for the original material and the separated fraction were determined and are reproduced. An additional test on a mixture of steel balls of $\frac{1}{8}$ and $\frac{1}{16}$ in. diameter was performed. The separated fraction contains spheres of more uniform size than the original sample. A possible explanation is suggested. S.Weintroub

539.216.1

2724. THE ORIENTATION OF THE STRUCTURE OF 6.6 NYLON FIBRES. M.F.Culpin and K.W.Kemp.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1301-8 (Dec., 1956).

The optical and X-ray diffraction properties of a model fibre have been considered. The fibre is assumed to consit of an assemblage of structural units to which simple optical and crystalline properties have been assigned. It is further assumed that the random orientation of units in the undrawn fibre is modified by drawing according to a simple geometrical pattern. Good agreement has been found between the observed variation of the birefringence with drawing, and the variation calculated from the model, and between some of the observed changes with drawing of the X-ray diffraction pattern, and the corresponding changes shown by the model. A.

539.217

2725. MECHANISM OF DIFFUSION OF COPPER IN GERMANIUM. F.C.Frank and D.Turnbull.
Phys. Rev., Vol. 104, No. 3, 617-18 (Nov. 1, 1956).

To explain the rapid diffusivity of copper in germanium and its dependence on structure, it is proposed that the copper is dissolved in two states, interstitial and substitutional. It is deduced that in the interstitial state the solubility of copper is about 10^{-2} times less and the diffusivity many orders of magnitude greater than in the substitutional state. Conversion from the interstitial to the substitutional state is effected by lattice vacancies which are generated at free surfaces and dislocations; this accounts for the structure dependence of diffusivity observed by Tweet and Gallagher. A.

539.217 : 537.311.33

RATE LIMITATION AT THE SURFACE FOR IMPURITY DIFFUSION IN SEMICONDUCTORS. See Abstr. 2197

539.219 : 537.531

2726. SOFT X-RAY SPECTROSCOPY OF SOLID SOLUTIONS OF ALUMINIUM AND MAGNESIUM. B.Gale and J.Trotter.
Phil. Mag. (Eighth Ser.), Vol. 1, 759-70 (Aug., 1956).

Soft X-ray L_{23} bands of aluminium and magnesium when each is dissolved in the other have been examined photographically. The widths and shapes of the solute bands differ considerably both from those of the solvents and the corresponding pure metals. An attempt has been made to correlate some of the changes in terms of a Thomas–Fermi treatment of the fields around impurity atoms. A.

539.23

2727. ON THE QUESTION OF THE RAYLEIGH–BEILBY FILM ON GLASS. E.Brüche and H.Poppa.
Z. angew. Phys., Vol. 8, No. 10, 486-92 (Oct., 1956). In German.

The authors have made a direct investigation by electron microscopy of the effect of polishing on the nature of a glass surface. They prove conclusively the existence of a surface film (the "Beilby film") a few millimicrons thick, which is formed under stress and which retains its fluidity for a time of order 10^{-4} sec. The film is likely to have different properties from the bulk glass. A semi-quantitative theory of the mechanism of polishing is given, together with 14 photographs of polished and semi-polished surfaces at magnifications up to 8500. R.O.Davies

539.234

2728. SURFACE BLOOM ON EVAPORATED ALUMINUM. W.G.Fastie.
J. Opt. Soc. Amer., Vol. 46, No. 10, 905-6 (Oct., 1956).

Experiments show that the bloom which occurs on thick Al evaporated films is a result of a low vacuum pressure. Flushing with oxygen is shown to give improved films, probably due to the "getter" effect of the hot Al. R.W.Fish

539.234

2729. METHOD OF OBTAINING UNIFORM EVAPORATED LAYERS. V.A.Vis.
J. Opt. Soc. Amer., Vol. 46, No. 10, 906-7 (Oct., 1956).

Calculations are given for the optimum proportions of a ring evaporating source in order to produce uniform layers. For a 3/8 in. radius layer, a thousand-fold improvement in uniformity is obtained over a point source. D.G.Avery

539.234

2730. TWO-COLOR MONITORING METHOD FOR REPRODUCING THIN FILM THICKNESSES. A.C.Traub.
J. Opt. Soc. Amer., Vol. 46, No. 11, 999-1000 (Nov., 1956).

Monitoring of thickness during deposition of monolayer dielectric films is done by observing the ratio of reflectance of the film at two wavelengths determined by narrow-pass filters. A chopper made of the two filters is used, and the condition of zero modulation of the reflected beam is observed. The method is claimed to be more sensitive than the use of monochromatic light, and avoids setting on maxima or minima of reflectance. D.G.Avery

539.234

2731. AGEING OF EVAPORATED ALUMINIUM FILMS. C.Weaver and R.M.Hill.
J. Phys. Radium, Vol. 17, No. 7, 604 (July, 1956). In French.

The greater adhesion of aluminium evaporated on glass, previously coated with chromium, is due to the formation of an intermetallic compound. R.A.Weale

539.26

2732. SUMMARIZED PROCEEDINGS OF A CONFERENCE ON THE STRUCTURES OF SEMI-CRYSTALLINE AND NON-CRYSTALLINE MATERIALS — LONDON, NOVEMBER 1955. R.E.Franklin and R.L.Gordon.
Brit. J. appl. Phys., Vol. 7, No. 11, 385-94 (Nov., 1956).

A conference held by the X-ray Analysis Group of The Institute of Physics. The three sessions dealt respectively with coals, cokes and carbons; with glasses, liquids and disordered structures; and with non-biological fibres. A.

539.26

2733. ON THE BROADENING OF AN X-RAY BEAM DUE TO PASSAGE THROUGH HETEROGENEOUS MATERIAL. M.Lambert and A.Guinier.
J. Phys. Radium, Vol. 17, No. 5, 420-5 (May, 1956). In French.

It is shown that the broadening of a narrow beam of X-rays passing through a thick sample consisting of fine particles is due to multiple low angle scattering. The particle size can be calculated from the variation in beam width with sample thickness. Powder samples of carbon black and ramie produced measurable beam broadening, while metal foils (Al, Cu, Ni) gave negative results. The latter is contrary to observations of Rovinskiĭ and Genkin (Abstr. 3907/1954). J.Adam

539.27

2734. REPLICA TECHNIQUE FOR SYSTEMATIC EXAMINATION OF A SURFACE UNDER THE ELECTRON MICROSCOPE. F.Nesh.
J. appl. Phys., Vol. 27, No. 10, 1252-3 (Oct., 1956).

A method is described for obtaining replicas from the inside of metal rings. A film of polystyrene is produced over the inner surface from solution, and left for 24-72 hours, by which time the film has shrunken away from the ring and can be easily removed. A second stage silica replica is prepared in the usual way. M.E.Haine

539.27

2735. REFLECTION ELECTRON MICROSCOPY: DIRECT OBSERVATION OF FRAGILE OBJECTS UNDER THE ELECTRON BEAM. R.Saporte.
J. Phys. Radium, Vol. 17, No. 6, 33 S (June, 1956). In French.

Fragments of objects e.g. textile fibres, which are unsuitable for study by direct transmission, are partially embedded in softened celluloid. A layer of Ag 2000 A thick is evaporated on the object, followed by a Cu layer, 0.3 mm thick, deposited electrolytically. The celluloid is removed and the metallized object is finally mounted on a Cu block. Such specimens are ideal for reflection microscopy. R.Reed

ELASTICITY. STRENGTH. RHEOLOGY

539.3/.8

539.31

2736. ON THE THEORY OF THE LOW-TEMPERATURE INTERNAL FRICTION PEAK OBSERVED IN METALS. A.Seeger.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 651-62 (July, 1956).

Recent data on polycrystalline copper suggest that the low-temperature internal friction mechanism in metals first observed by Bordoni is determined by intrinsic properties of dislocations. This is contrary to an explanation by Mason according to which the activation energy of the process should depend on the impurity content of the material and the separation between dislocation nodes. A mechanism proposed elsewhere seems to account for all the major features of the experimental results. The relaxation phenomenon is thought to be due to dislocations which are confined by the Peierls stress to certain crystallographic directions. Under the combined action of thermal fluctuations and the applied stress they may form pairs of kinks. Internal friction peaks are observed if the frequency of the applied alternating shear stress is equal to the frequency of the formation of these kink pairs. The Peierls stresses deduced from the experimental results are rather large, being of the order of one thousandth of the shear modulus. A.

539.313

2737. ON THE FUNDAMENTALS OF THE THEORY OF ELASTICITY OF PHYSICALLY NON-LINEAR NON-HOMOGENEOUS BODIES. W.Olszak and M.Życzkowski.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 2, 63-72 (1956).

General stress—strain relations and equations of motion are considered for elastic bodies with variable moduli depending explicitly on the space coordinates as well as on the strains. The possibility of classifying such bodies is discussed. A study of the torsion of a circular cylindrical bar is used to illustrate the theory. J.G.Oldroyd

539.32

2738. ANISOTROPY OF ELASTIC PROPERTIES OF SINGLE CRYSTALS OF GALLIUM. M.Erny, R.Cabarat, A.Defrain and I.Epelboin.
C.R. Acad. Sci. (Paris), Vol. 242, No. 23, 2698-9 (June 4, 1956). In French.

A dynamic method is used to determine Young's modulus of cylindrical specimens of Ga single crystals having different orientations. The elastic constants in the relationship between the modulus and the orientation are derived. The modulus is of the order of 10 000 kg/mm^2 and shows little variation with temperature between 18°C and the melting point (29.75°C). H.J.H.Starks

539.32

2739. DYNAMIC ELASTIC MODULI OF IRON, ALUMINUM, AND FUSED QUARTZ. D.S.Hughes and C.Maurette.
J. appl. Phys., Vol. 27, No. 10, 1184-6 (Oct., 1956).

The dynamic elastic constants of Armco iron, pure aluminium, and fused quartz have been measured with a supersonic pulse technique as functions of pressure and temperature over the range 1 to 9000 bars and 25° C to 300°C (200°C for quartz). Within the experimental accuracy the dynamic elastic moduli of these materials can be represented by linear functions of pressure and temperature. The isothermal bulk moduli of other observers have been used to compute the equivalent adiabatic moduli by use of the thermodynamic relations. Comparison shows that at high pressures the dynamic moduli agree with the adiabatic moduli within the experimental accuracy for iron and aluminium. At low pressure the dynamic modulus of Armco iron is less than the adiabatic. The deviation is small but is about four times the estimated probable error. A.

539.32 : 538.245

2740. THE ELASTICITY AND ANTIFERROMAGNETISM OF Cr_2O_3. R.Street and B.Lewis.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 663-8 (July, 1956).

Measurements have been made of Young's modulus of pressed bars of Cr_2O_3 as a function of temperature. Near the Néel temperature an anomalous variation of modulus is observed. The character of this anomaly is however completely different from the anomalies previously observed for NiO and CoO. It is suggested that the difference is a domain phenomenon: the structure of NiO and CoO, but not of Cr_2O_3, allows the existence of antiferromagnetic domains. A.

539.32

2741. SOME ELASTIC PROPERTIES OF ORGANIC GLASSES IN THE TRANSITION REGION FROM SOLID TO LIQUID AT ULTRASONIC FREQUENCIES. S.M.Crawford.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1312-18 (Dec., 1956).

Measurements have been made of the dynamic shear properties of four organic glasses at a frequency of 4 Mc/s and over a wide temperature range covering the softening region. The behaviour of the shear modulus is in accord with the chemical nature of these materials. Correlation of these results with measurements of the velocity of longitudinal waves at the same frequency suggests that there is a relaxation in the bulk modulus between the solid and liquid state, as has been reported by Kuhn and Vielhauer, but at a somewhat lower temperature than the relaxation in the shear modulus. A.

539.32 : 539.11

CALCULATION OF THE ELASTIC SHEAR CONSTANTS OF MAGNESIUM AND MAGNESIUM ALLOYS. See Abstr. 2460

539.371 : 539.374

2742. STUDY OF STRESSES IN CRYSTALS OF SILVER CHLORIDE DURING ELASTO-PLASTIC BENDING. B.A.Kuznetsov.
Zh. tekh. Fiz., Vol. 26, No. 7, 1611-21 (1956). In Russian.

See also Abstr. 5707/1949 and 2729/1950. The AgCl specimens, tested in a specially designed stressing apparatus, were 1mm thick and 7-7.5 mm high, these dimensions corresponding to 1 and 5 grains, respectively. Some specimens had semicircular notches 0.5-1 mm in diameter. It was found that the optical activity of AgCl did not change on passing from the elastic into the plastic region. The bending stress distribution was studied in the smooth and notched coarse-grained specimens: outer portions of smooth specimens showed a smaller resistance to plastic deformation than the interior (probably because the hardening due to the bending of glide packets was less at the edge). Presence of notches highly increased the flow limit of the crystal on bending. F.Lachman

539.373

2743. THE MECHANISM OF WORK SOFTENING IN ALUMINIUM. A.Kelly.
Phil. Mag. (Eighth Ser.), Vol. 1, 835-45 (Sept., 1956).

The appearance of slip lines on polished surfaces of aluminium crystals has been studied under the optical microscope as a function of plastic extension at 90°K and at room temperature. Measurements have been made of the lengths of the slip traces produced by the emergence of screw and edge dislocation segments. During deformation at both temperatures the first slip lines produced are long and straight. Further deformation at 90°K results in the appearance of shorter slip traces whilst at room temperature cross slip is observed. Crystals strained at one temperature and subsequently deformed at a higher temperature show a yield point (work softening); this is accompanied by an increase in the amount of cross slip and in the intensity of cross slip traces. The result is discussed in terms of dislocation movements. A.

539.374

2744. THE PLANE PROBLEM OF THE THEORY OF PLASTIC FLOW OF NON-HOMOGENEOUS BODIES. W.Olszak.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 3, No. 3, 119-24 (1955).

The yield conditions applicable to the plane stress and plane strain problems for a class of non-homogeneous bodies are derived from earlier work (Abstr. 724/1956, 798/1957) and the case of a thick walled non-homogeneous cylinder whose elastic properties depend on its radius is briefly discussed. J.E.Caffyn

539.374

2745. ON A CLASSIFICATION OF NON-HOMOGENEOUS ELASTO-PLASTIC BODIES. W.Olszak.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 1, 29-35 (1956).

A continuation of previous work (see Abstr. 724/1956, 698/1957). Subdivisions of the class of nonhomogeneous elastoplastic bodies in which the stress is not appreciably dependent on the rate of shear are enumerated. The general types of stress–strain law, for loading and for unloading, are discussed briefly. J.G.Oldroyd

539.374

2746. APPLICATION OF THE METHOD OF "ASSUMING AN EXACT EQUATION" IN SOME PROBLEMS OF ELASTOPLASTIC STABILITY. M.Życzkowski.
Bull. Acad. Polon. Sci. Cl. 4, Vol. 4, No. 1, 37-43 (1956). In German.

An application of the theory developed in Bull. Acad. Polon. Sci. Cl. 4, Vol. 3, No. 3, 129-34 (1955). Calculations are made of the buckling loads for a uniformly tapering steel bar in longitudinal compression, as functions of two parameters defining the cross-section and its variation, when (i) the bar is clamped at one end and free at the other (except for the applied axial load), and (ii) the bar is simply supported at both ends. J.G.Oldroyd

539.374

2747. ELASTIC-PLASTIC DEFORMATION OF A THICK-WALLED SPHERICAL VESSEL SUBJECTED TO INTERNAL PRESSURE. W.Urbanowski.
Bull. Acad. Polon, Sci. Cl. 4, Vol. 4, No. 2, 73-8 (1956).

The distributions of stress and of displacement are determined as functions of the internal pressure when the material of the wall of the vessel can exist in three states: an elastic state, a perfectly plastic state (for a limited range of strains beyond the elastic limit) and a strain-hardening plastic state (for greater strains). In a certain range of internal pressures, the three states of the material occur simultaneously in different spherically symmetrical regions of the vessel wall, provided this is sufficiently thick. J.G.Oldroyd

539.374

2748. THE NATURE OF THE DISTORTIONS ON THE GLIDING PLANES OF METALS. V.S.Ivanova.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 2, 217-20 (1954). In Russian.

The author considers results of his experimental investigations of the plastic distortion of iron and steel. Part of the experiments consisted in employing the cine-camera for the direct observation of the process of plastic flow. It is concluded that plastic extension progresses discontinuously and that the onset of the movement on gliding planes is associated with a "critical" strain of the grain. Relations between plastic distortion and work hardening are discussed in some length. R.Eisenschitz

539.374 : 534.2

2749. THE PROPAGATION OF STRESS PULSES IN VISCOELASTIC SOLIDS. H.Kolsky.
Phil. Mag. (Eighth Ser.), Vol. 1, 693-710 (Aug., 1956).

The propagation of short mechanical pulses along rods of three polymers, polythene, polystyrene and polymethylmethacrylate, has been investigated experimentally. The pulses were produced by the detonation of small quantities of explosive at one end of a rod and a condenser microphone was employed to record the displacement of the opposite end. It is shown that if the response of the material to sinusoidal stresses over a wide frequency range is known, the pulse shapes can be predicted accurately by means of a numerical Fourier synthesis. Further, that where the damping loss is not too large and is constant over a wide frequency range, as it is for many polymers, a general solution of the problem can be obtained which gives the pulse shape for all such polymers and for all distances of travel. Some experiments on pulses through blocks of plastic are also described. A.

539.374 : 548.7

2750. THE STRESS TO MOVE A FREE DISLOCATION IN ALPHA IRON. J.Heslop and N.J.Petch.
Phil. Mag. (Eighth Ser.), Vol. 1, 866-73 (Sept., 1956).

It is shown that the portion of this stress due to interaction with random C and N atoms is temperature-independent. At low temperatures, another, very temperature-dependent portion is dominant, and this is interpreted as evidence of a sizeable Peierls–Nabarro force in α-iron. A.

539.389.3 : 537.226.2

2751. INVESTIGATION OF THE COPOLYMER RELAXATION TIME DEPENDENCE ON CONCENTRATION BY THE METHOD OF DIELECTRIC LOSSES. G.P.Mikhaĭlov and L.V.Krasner.
Zh. tekh. Fiz., Vol. 26, No. 8, 1738-40 (1956). In Russian.

Experiments conducted on copolymers of methyl methacrylate with styrene and of methylvinylketone with styrene have shown that the time of relaxation of the dipole-elastic losses (corresponding with the second maximum of tan δ) depends on the concentration of the polar constituent (methyl methacrylate or methylvinylketone). This finding shows that copolymers behave like polar solutions, when in a highly elastic state, and like mixtures, when in solid state (at low temperatures). F.Lachman

539.4.016 : 539.431

2752. EFFECT OF FATIGUE STRESSES ON THE RECOVERY PROPERTIES OF METALS. A.J.Kennedy.
Nature (London), Vol. 178, 810-11 (Oct. 13, 1956).

The rate of recovery from the work hardening brought about by creep is accelerated in lead by the application of a low-level 300 c/s fatigue stress. Prolonged application of the stress brings about a rehardening which, it is suggested, is associated with the development of fatigue in the metal. The results are discussed in terms of the generation and diffusion of vacancies. A.J.Kennedy

539.4.016.2

2753. LOW TEMPERATURE RELEASE OF STORED ENERGY IN COLD WORKED COPPER. J.W.Henderson and J.S.Koehler.
Phys. Rev., Vol. 104, No. 3, 626-33 (Nov. 1, 1956).

Pure polycrystalline copper and alpha-brass specimens were deformed in compression at temperatures near -185°C. The release of stored energy was observed during subsequent warmups to room temperature and above. The annealing spectrum of pure copper shows prominent peaks at -25°C and -90°C, and smaller resolvable peaks at lower temperatures. The total energy release was about 0.17 cal/g for a specimen strained to 0.65. In contrast to pure copper, the spectrum for brass shows only one clearly resolvable peak at -10°C and extends to higher temperatures. The energy release was almost three times that of pure copper for comparable strains. The sensitivity of the experimental method is about 10^{-4} cal/g per degree centigrade, and the results are believed to be accurate to about 30%. The apparatus was calibrated by measuring the known heat-of-fusion of mercury. A tentative theory of the multiple peaks in the rate of energy release below -70°C is given. This theory supposes that the moving imperfections in this temperature range are divacancies and that the energy of motion of a divacancy is different depending on its orientation in the internal stress field. A.

539.42

2754. DELAYED FRACTURE OF SINTERED ALUMINA. S.Pearson.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1293-6 (Dec., 1956).

The strength of sintered alumina, when tested in the normal atmosphere, is shown to depend on the time for which the stress is applied. When stressed in bending under constant load, the average time to fracture increases from 1 sec to 10^6 sec when the stress is reduced by about 22%. This delayed fracture can be largely eliminated by heat treating and testing in a vacuum. The vacuum heat treatment does not change the strength of the material permanently since the delayed fracture effect reappears when the material is again exposed to the atmosphere. It is concluded that the effect is due to attack of the stressed material by constituents of the atmosphere. A.

539.434 : 539.21

2755. CREEP OF ALPHA URANIUM DURING IRRADIATION WITH NEUTRONS. A.C.Roberts and A.H.Cottrell.
Phil. Mag. (Eighth Ser.), Vol. 1, 711-17 (Aug., 1956).

During neutron irradiation at 100°C alpha–uranium creeps slowly (e.g. 10^{-7} per hour) under external stresses of order of one-hundredth of the normal yield stress of the metal at that temperature. This effect is predicted as a consequence of the phenomenon of "radiation-growth" which occurs in uranium, and is then confirmed by creep experiments on helical springs of natural uranium in a flux of 1.3×10^{12} thermal neutrons per cm^2 per sec. In addition to this steady-state creep, transient effects occur at the start of irradiation and when the neutron flux is removed. A.

539.434

2756. ON THE MECHANISM OF HIGH-TEMPERATURE CREEP IN METALS WITH SPECIAL REFERENCE TO POLYCRYSTALLINE LEAD. P.Feltham.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1173-88 (Dec., 1956).

On the basis of Mott's suggestion that intracrystalline deformation in creep takes place by fine slip, and that the activation energy is that for the motion of screw dislocations impeded by jogs, expressions for the high-temperature transient and equilibrium creep rates are obtained in terms of the applied stress, the temperature, the grain size and the characteristics of the intragranular substructure. The equations give a good interpretation of the known creep behaviour of a number of metals as reported in the literature. The synthesis is based primarily on lead as, in conjunction with the present experiments, the available literature provides a fairly comprehensive account of the creep of both single crystals and polycrystals of this metal. A.

539.56

2757. BRITTLE FRACTURES NEAR EQUILIBRIUM. F.C.Roesler.
Proc. Phys. Soc. B, Vol. 69, Pt 10, 981-92 (Oct., 1956).

Conical indentation fractures in silicate glass are stable, so that the speed at which they spread can be controlled. The validity of the Griffith fracture condition (energy balance) has been tested for such fractures and confirmed, with qualifications. Measurements on cone fractures are a method for determining accurately the specific fracture energy of brittle materials under physical and chemical conditions that can be chosen at will. A.

539.576

2758. LAW OF ADHESIVE WEAR. J.T.Burwell.
J. appl. Phys., Vol. 27, No. 12, 1561 (Dec., 1956).

True contact area between surfaces as determined by Meyer's Law and discussed by Tabor, varies with load W according to relation $A = cW^{2/n}$, (c constant, $2.0 < n < 2.5$). This predicts almost linear dependence of wear volume on load and not the exponential relation suggested by Bhattacharyya (Abstr. 804/1957). Rapid increase in wear volume with load cannot be explained in terms of the area/load relation alone but must be due to some self-accelerating characteristic of the welding mechanism. J.W.Menter

539.576

2759. THE RELATION BETWEEN WEAR AND DISTANCE RUN, FOR STEEL AND COATED STEEL SURFACES. M.R.Piggott.
Proc. Phys. Soc. B, Vol. 69, Pt 8, 857-8 (Aug, 1956).

An experimental relation is found between wear W (measured by loss in weight) and distance run D, of form $W = c \log kD$ where c and k are constants; this relation holds for steel rubbing against steel coated with FeS or Fe_3O_4 or against clean steel. It does not hold for steel coated with α-Fe_2O_3. It appears that the main factor determining the wear properties is the formation of a composite surface layer subjected to plastic flow, and that the shape and smoothness of the surfaces is more important than the presence of a surface film. N.Corcoran

539.62

2760. A GENERAL THEORY OF THE SURFACE FRICTION OF SOLIDS. C.Rubenstein.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 921-33 (Sept., 1956).

The theory of the surface friction of solids which is developed is based on the assumptions that the adhesion theory of friction is valid and that the asperities, at which contact occurs, deform according to the law stress $\propto$ (strain)^x. A roughness model is postulated in which the asperities (either spherical or cylindrical) (a)are uniformly distributed over the surface, (b) have the same radius of curvature and (c) all protrude from the surface by the same amount. The analysis leads to the equation $F = CL^{\beta}$ relating the frictional force F to the normal load L, an equation which has been found empirically by several investigators. The parameter C is shown to be dependent on the physical properties of the sliding materials, on the degree of surface roughness and on the apparent area of contact, and hence, on the geometrical arrangement of the sliding surfaces, while the parameter β is dependent on the physical properties of the sliding materials only. Amontons' laws of friction (the particular case of the above equation when β is unity) are shown to be interdependent, and when these are obeyed the frictional force is shown to be independent of the degree of surface roughness provided this is not excessive. The influence of surface roughness on the frictional force, found experimentally, is shown to be in accordance with deductions based on the adhesion theory of friction and opposed to deductions based on the Coulomb theory of friction. A.

539.893

2761. COMPRESSION OF [LIQUID] OXYGEN UNDER VERY HIGH PRESSURES PRODUCED BY SHOCK WAVES IN THE LIQUID. J.Dapoigny, J.Kieffer and B.Vodar.
J. Phys. Radium, Vol. 17, No. 7, 606-7 (July, 1956). In French.

Continuation of previous work (see Abstr. 965/1956). The technique used for liquid argon was employed. The dynamic adiabatic of liquid oxygen (spec. volume 0.862 at the atmospheric pressure and the b.p.) was determined at pressures up to 83 000 kg/cm^2 by means of shock waves produced in the liquid. Owing to the smaller value of the coefficient of absorption of X-rays in oxygen, the diameter of the vessels containing the liquid oxygen was increased to 7 and 10 mm compared with the diameters of 4 and 8 mm used with liquid argon. The results are shown graphically. J.S.G.Thomas

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM. CHEMICAL REACTIONS 541.11/.12

541.124

2762. MECHANISM OF THE ISOMERIZATION OF CYCLOPROPANE. J.R.McNesby and A.S.Gordon.
J. chem. Phys., Vol. 25, No. 3, 582-3 (Sept., 1956).

The result of pyrolyzing mixtures of cyclopropane and deuterium was investigated by means of gas chromatography and the mass spectrometer. It is concluded that the mechanism

$$\begin{array}{l} CH_2 \\ / \quad \backslash \\ CH_2-CH_2 \end{array} \rightarrow CH_2=CH-CH_2$$

is probably correct. W.Good

541.124

2763. ISOTOPE FRACTIONATION STUDIES OF REACTIONS WITH CLEAVAGE OF A CARBON-14 TO HYDROGEN BOND IN THE RATE-DETERMINING STEP. G.A.Ropp and E.M.Hodnett.
J. chem. Phys., Vol. 25, No. 3, 587-8 (Sept., 1956).

C^{14} fractionation studies of

(a) $CH_3.HC^{14}OH.CH_3 \xrightarrow[37.5^\circ C]{\text{chromic acid}} CH_3.C^{14}O.CH_3$

(b) $C_6H_5.C^{14}H_2OH \xrightarrow[37.5^\circ C]{\text{chromic acid}} C_6H_5.C^{14}HO$

(c) $CH_3.CO.C^{14}H_3 \xrightarrow[25^\circ C]{I_2 + NaOH} C^{14}H_3.COONa + C^{14}HCl_3$

show no measurable isotope fractionation for reactions (b) and (c), but for reaction (a) the mean value of $k_{C^{12}}/k_{C^{14}} = 1.035$. The isotope effect in (a) is thought to be a composite of (i) the oxidation of 2-propanol by $HCrO_4$ (ii) the subsequent oxidation of two molecules of 2-propanol by Cr(iv) and Cr(vi). G.Allen

541.124

2764 SHOCK WAVES IN CHEMICAL KINETICS: FURTHER STUDIES ON THE RATE OF DISSOCIATION OF MOLECULAR IODINE. D.Britton, N.Davidson, W.Gehman and G.Schott.
J. chem. Phys., Vol. 25, No. 5, 804-9 (Nov., 1956).

For previous work see Abstr. 5007 (1955). The rate of the dissociation reaction $M + I_2 \underset{k_R}{\overset{k_D}{\rightleftharpoons}} M + I + I$, has been measured by the shock tube method for argon, helium, nitrogen, oxygen and carbon dioxide as inert gases, M, in the temperature range 1000°-1600°K. The shock wave results by themselves and the comparison of the shock-wave measurements with the room temperature measurements of k_R by flash photolysis both show that k_R has a negative temperature coefficient. The absolute value of this negative temperature coefficient derived from the shock-wave measurements is greater than the value derived from comparison of the average high temperature result with the room temperature result for any particular gas. This may be due to experimental error in the determination of dk_R/dT at the high temperatures, but it is believed that the values of k_R determined in the middle of the temperature range studied are reliable. The experimental evidence indicates that, for the measurements with CO_2, the rate of vibrational equilibration is so fast that the observations made here pertain entirely to vibrationally equilibrated CO_2. Evidence from other experiments indicates that the rate of vibrational relaxation in oxygen is such that most of the dissociation reaction occurs in relaxed O_2, but that nitrogen remains vibrationally unexcited under the conditions of the dissociation reactions studied here. The ratio, $k_{R,I_2}/k_{R,A}$, of the efficiencies of iodine and argon as third bodies is not greater than 30 at 1300°K whereas it is 2.0-600 at room temperature. The hypothesis is proposed that in general the ratio $k_{R,gas}/k_{R,A}$ for complex gases will decrease with increasing temperature. A.

541.124

2765. SHOCK WAVES IN CHEMICAL KINETICS. RATE OF DISSOCIATION OF MOLECULAR BROMINE. D.Britton and N.Davidson.
J. chem. Phys., Vol. 25, No. 5, 810-13 (Nov., 1956).

The rate of dissociation of molecular bromine in argon–bromine mixtures has been measured in a shock tube and the rate constants for the reaction $Br + Br + M \xrightarrow{k_R} Br_2 + M$, in the temperature range 1400°-2700°K, computed. The data are not sufficiently accurate to reveal the temperature coefficient of k_R. However, comparison of the average high temperature result, $k_R = 3.4 \times 10^8$ litre^2 mole^{-2} sec^{-1} at 1600°K, with the room temperature flash-lamp result, $k_R = 2.5 \times 10^9$, shows clearly that dk_R/dT is negative. Experiments were performed with bromine : argon ratios of 0.01 to 0.10; the efficiency of Br_2 as M, the third body for the recombination of bromine atoms, is not greater than 8 times that of argon. The agreement of the results of this investigation with those of an independent shock tube investigation by Palmer and Hornig is good. The extinction coefficients of bromine at 436 mμ and 487 mμ were measured as a function of temperature. A.

541.126 : 541.13 : 539.132

2766. PARA-LOCALIZATION ENERGY AND POLAROGRAPHIC HALF-WAVE POTENTIALS OF POLYNUCLEAR HYDROCARBONS. S.Basu and R.Bhattacharya.
J. chem. Phys., Vol. 25, No. 3, 596-7 (Sept., 1956).

These two quantities (the former from π-electron LCAO MO theory, the latter experimental) are approximately proportional in two-electron polarographic reductions, supporting the hypothesis that the free-energy change is mainly determined by the change in π-electron energy in going to the transition complex. J.Hawgood

541.126 : 536.46

2767. GASEOUS DETONATIONS. IX. A STUDY OF THE REACTION ZONE BY GAS DENSITY MEASUREMENTS. G.B.Kistiakowsky and P.H.Kydd.
J. chem. Phys., Vol. 25, No. 5, 824-35 (Nov., 1956).

For Pt VIII, see Abstr. 8444 (1956). An X-ray absorption photometer capable of measuring gas densities with extreme rapidity and reasonable accuracy has been developed to study the reaction zone in detonation waves. At low initial gas pressures this zone is readily observable as a density peak at the wave f ont lasting a few μsec. In general the results agree with the hydrodynamic theory of the detonation wave. The observed densities at the end of the reaction zone (the Chapman–Jouguet state) compare well with the results of approximate equilibrium calculations and the observed shape of the density profile qualitatively confirms kinetic predictions. However, the observed peak densities are substantially lower than expected and the initial chemical reaction rates are faster. The most plausible explanation at present seems to be a lack of equilibration between translational and internal degrees of freedom in the shocked gas, lasting long enough for a substantial progress of the chemical reactions to take place. The duration of the reaction zone in the mixtures studied is inversely proportional to the initial pressure of the detonating gas. This is true of the stoichiometric mixtures of hydrogen and oxygen which were studied most intensively. On varying the composition of these mixtures it is found that the duration is inversely proportional to the partial pressure of hydrogen and is independent of that of oxygen. An increase of the total pressure by the addition of a rare gas accelerates the reaction. Nitrogen and water vapour act as inert additives. Replacement of some hydrogen by carbon monoxide does not alter the duration of the reaction zone. On the other hand, when small quantities of hydrogen are added to stoichiometric carbon monoxide–oxygen mixtures, the reaction times are found to vary as $P_{H_2}^{-1/2}$. The addition of nitrogen has little effect on these mixtures but carbon dioxide proves to be strong inhibitor. Methane reacts with oxygen at a rate which is comparable with that observed for hydrogen, while acetylene oxidation is very much faster. A.

541.126

2768. APPLICATION OF PROBABILITY THEORY TO EXPLOSIVE-IGNITION PHENOMENA. R.B.Parlin and J.C.Giddings.
J. chem. Phys., Vol. 25, No. 6, 1161-6 (Dec., 1956).

The problem of explosive ignition concerns itself both with the probability of occurrence of local energy fluctuations and with the

transition of these disturbances into a combustion or detonation wave. The former concept does not appear to have been comprehensively discussed; a treatment of this process is presented here for the case of fluctuations due to frictional forces. The theory is applied to several cases of impact ignition, both with and without grit particles and it is found to be in good agreement with experiment. Information is obtained through application of the theory concerning the nature and location of the local disturbances responsible for ignition. A.

541.126 : 536.46 : 535.333

FORMATION OF CARBON PARTICLES IN FLAMES. See Abstr. 2007

541.127

2769. "ACCELERATION" OF CHEMICAL REACTIONS.
C.J.G.Raw and W.Yourgrau.
Nature (London), Vol. 178, 809 (Oct. 13, 1956).

The differential coefficient of the velocity of a chemical reaction with respect to time ($\dot{v}$) is defined as the "acceleration". From Prigogine's theorems it is shown that

$$\dot{v} = \left(\frac{\partial \ln A}{\partial \xi}\right)_{p,T} v^2 = \frac{d^2\xi}{dt^2},$$

where A = the affinity and ξ = the degree of advancement of the reaction. The acceleration is found to have the opposite sign to the affinity under the conditions where Prigogine's theorems are valid.

G.Allen

541.128 : 535.37

2770. CONNECTION BETWEEN THE CATALYTIC PROPERTIES OF ZINC OXIDE AND SULPHIDE AND THEIR LUMINESCENCE.
L.N.Shekhter, I.A.Myasnikov and S.Ya.Pshezhetskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1163-6 (1956). In Russian.

A comparison of the catalytic activities of specimens of zinc oxides and sulphides with their luminescence spectra proves that the more active specimens of both are those having excess metal ions.

R.C.Murray

ELECTROCHEMISTRY 541.13

541.132

2771. NUCLEAR SPIN RESONANCE OF AQUEOUS SODIUM ION.
J.E.Wertz and O.Jardetzky.
J. chem. Phys., Vol. 25, No. 2, 357-8 (Aug., 1956).

The nuclear magnetic resonance spectrum of Na^+ ions has been studied in fields of 7030 gauss. For most solutions the line width is constant at 32 mgauss between points of maximum slope and independent of concentration. Under these circumstances, the intensity is proportional to the concentration as found with Cl^-, F^-, Br^-, $S^=$, N_3^-, $SO_4^=$ and $Fe(CN)_6^{\equiv}$ as anions. For high concentrations above 6 N of ClO_4^-, I^-, SCN^-, and OH^- the line broadens and eventually at the highest concentrations the line weakens; this phenomenon is attributed to quadrupole interactions in non-spherical complexes or ion pairs.

D.H.Whiffen

541.135.1

2772. THE RELATIONSHIP BETWEEN THE COMPOSITION OF SOLUTIONS AND THE DEPOSIT IN THE ELECTRODEPOSITION OF TWO-COMPONENT ALLOYS. E.I.Akhumov and B.Ya.Rozen.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1149-51 (1956). In Russian.

It is deduced that in the electrodeposition of a two-component alloy from aqueous solution, $\log([M_1]/[M_2]) = A + B \log([M_1^{n+}]/[M_2^{n+}])$, where A and B are constants; $[M_1]$, $[M_2]$ are the concentrations of the alloy components; $[M_1^{n+}]$, $[M_2^{n+}]$ are the concentrations of the ions in the aqueous phase (assumed to be of the same charge number and the same activity coefficients). This equation fits published results for Cu–Zn, Cu–Sn, Sn–Zn and Ag–Cd alloys.

R.C.Murray

541.135.5

2773. AN ALL-GLASS REFERENCE ELECTRODE FOR MOLTEN SALT SYSTEMS. J.O'M.Bockris, G.J.Hills, D.Inman and L.Young.
J. sci. Instrum., Vol. 33, No. 11, 438-9 (Nov., 1956).

The construction and performance is described of a glass electrode generally applicable to molten salt systems up to 550°C.

A.

PHOTOCHEMISTRY. RADIATION CHEMISTRY 541.14/.15

541.15

2774. THEORY OF RADIATION CHEMISTRY. III. RADICAL REACTION MECHANISM IN THE TRACKS OF IONIZING RADIATIONS. A.K.Ganguly and J.L.Magee.
J. chem. Phys., Vol. 25, No. 1, 129-34 (July, 1956).

For Pt II, see Abstr. 6298 (1953). Develops a model for the dissipation of the tracks of high-energy particles. It is assumed that all chemical effects are due to one kind of radical and that there are no effects of overlapping of neighbouring tracks, i.e., that there is a sufficiently high concentration of scavenger to prevent such overlapping. The model of Samuel and Magee is used and extended to take into account the interaction of randomly distributed spurs along the track. Calculated values of the extent of scavenger reactions and radical reactions are presented in graphical form. General trends of experimental results to be expected according to the model are indicated. Quantitative correlation with experiments was not attempted because of the uncertainty in the values of various parameters used and because of the serious limitations of the one-radical model of tracks. A.

541.15

2775. EFFECT OF RADIATION UPON THE EXCHANGE OF HYDROGEN AND ETHANOL. J.G.Burr, Jr.
J. chem. Phys., Vol. 25, No. 3, 587 (Sept., 1956).

The irradiation of ampules containing 0.08 m moles of H_2 (tritium content 5 μc) and 16 m moles of EtOH shows that with partial pressures of H_2 up to 1 atmosphere and with doses of γ-radiation of 10^{23} eV per mole of EtOH, the induced exchange between molecular H_2 and EtOH is less than 0.002% of the H atoms available for exchange. Thus exchange between molecular H_2 and combined hydrogen can probably be neglected in considering the radiolysis of a labelled organic molecule which can react with H atoms.

G.Allen

541.15

2776. ION–MOLECULE REACTIONS IN RADIATION CHEMISTRY.
G.G.Meisels, W.H.Hamill and R.R.Williams, Jr.
J. chem. Phys., Vol. 25, No. 4, 790 (Oct., 1956).

The radiolysis of methane in rare gas atmosphere was studied in the presence and absence of iodine vapour. Analysis was made by mass spectrometer. 50 kV X-radiation and 1.5 MeV electrons produced hydrogen, ethane and propane and small amounts of higher alkanes. When deuterium was added H_2 and HD appeared, indicating the formation of both molecular and atomic hydrogen. C_2H_4 is formed in the presence of iodine when A, but not when Kr, is used. The reactions are interpreted on the basis of ion–molecule reactions, and deductions are made about probable radical intermediates. M.Ebert

541.15

2777. X- AND γ IRRADIATION OF FERROUS SULFATE IN DILUTE AQUEOUS SOLUTION. J.L.Haybittle, R.D.Saunders and A.J.Swallow.
J. chem. Phys., Vol. 25, No. 6, 1213-17 (Dec., 1956).

The yield for the X- and γ-ray induced oxidation of ferrous ions in acid aqueous solution has been determined for X- and γ-rays of effective mean energies from 21 keV to 7.6 MeV. For 60 kVp X-rays of effective mean energy, $\bar{E}$, 21 keV, $G = 13.1 \pm 0.5$ ferric ions produced per 100 eV absorbed; for 100 kVp X-rays ($\bar{E}$ = 33 keV) $G = 14.7 \pm 0.5$; for 220 kVp X-rays ($\bar{E}$ 56 keV), $G = 15.0 \pm 0.5$; for Co^{60} γ-rays ($\bar{E}$ = 1.25 MeV), $G = 15.5 \pm 0.5$; and for 30 MeV X-rays ($\bar{E}$ = 7.6 MeV), $G = 16.3 \pm 0.6$. In each case the energy absorbed in the solution was estimated by means of an ionization chamber. A.

541.15

2778. TYPE OF ACTION OF Co^{60} GAMMA RADIATION ON p-DICHLOROBENZENE. A. Monfils and J.Duchesne.
Physica, Vol. 22, No. 9, 818-20 (Sept., 1956). In French.

The quadrupole nuclear resonance line of Cl^{35} in p-dichlorobenzene is reduced to 20% by a dose of 5×10^8 r, but it recovers with time to its normal value. If the material is cooled to 77° K immediately after exposure and the measurements carried out at 20° C, an additional and similar effect was found, which could be simulated by mechanical stress. The kinetics of the recovery process are discussed. M.Ebert

541.15

2779. CHEMICAL EFFECTS OF ULTRASONICS — "HOT SPOT" CHEMISTRY. M.E.Fitzgerald, V.Griffing and J.Sullivan.
J. chem. Phys., Vol. 25, No. 5, 926-33 (Nov., 1956).

This work was undertaken with the purpose of considering why and how reaction takes place in an ultrasonic field, rather than studying the chemical kinetics of such reactions. Experimental evidence is presented which supports the conclusions that chemical processes brought about by ultrasonics require cavitation. Furthermore, the experiments were planned so as to show whether the reactions take place in the bubble or at the interface by studying the effect of the thermal conductivity and of the ratio of the heat capacities of various dissolved gases and their mixtures on the yields. From the results it was concluded that primary reactions seem to be gas phase reactions, probably of a thermal nature, taking place inside the gas bubbles which serve as "hot spots" in the liquid. The calculations show that, under the experimental conditions reported here, temperatures of several hundreds or thousands degrees can be easily reached inside the cavitating bubbles in resonance with the sound field; it is believed that at these temperatures the reaction which gives rise to H_2O_2 takes place. At this time it is not possible, however, to rule out completely the concomitant effects of gaseous discharge as suggested by others. It was also found that in conducting experiments like those in the present work, the cavitation threshold should be determined, effective intensities used, and systems maintained as simple as possible. A.

DISPERSIONS. COLLOIDS. ADSORPTION 541.18

541.182.4

2780. NATURE OF AGEING OF HIGHLY CONCENTRATED EMULSIONS. L.Ya.Kremnev, S.V.Nerpin and N.I.Kuĭbina.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 6, 1152-5 (1956). In Russian.

It has been established that after a certain induction period, determined by the properties of the stabilizer, disperse phase from a highly concentrated emulsion separates out on the surface and forms a continuous film. After the surface is completely covered, the breaking up of the emulsion below the surface auto-accelerates. This is interpreted in terms of the formation of large drops by coalescence of small ones, and growth by distillation of small drops onto larger ones. Initially drops in the surface can increase by coalescence and distillation on the emulsion side, and distillation on the gas side; when the surface is completely covered with coalesced condensed disperse phase, aggregation of disperse phase in the body of the emulsion becomes more rapid, and is accelerated by increase of the surface area of the flocculated disperse phase.
R.C.Murray

541.183.2

2781. STICKING PROBABILITY OF CARBON MONOXIDE ON EVAPORATED NICKEL FILM. Z. Oda.
J. chem. Phys., Vol. 25, No. 3, 592-3 (Sept., 1956).

The "sticking probability" s is measured by a constant flow method. From $\theta = 0$ to $\theta = 0.2$ (where θ = fraction of surface covered) s remains constant at 0.6 and then falls rapidly to $\sim 10^{-6}$ at $\theta = 0.8$. It is inferred that the fast adsorption before completion of a monolayer is a two-fold process. S.J.Gregg

541.183.2

2782. CONCERNING A THEORY OF MULTILAYER ADSORPTION, WITH PARTICULAR REFERENCE TO ADSORBED HELIUM. W.A.Steele.
J. chem. Phys., Vol. 25, No. 5, 819-23 (Nov., 1956).

A discussion is given of adsorption systems where the energy of an atom in the second layer is appreciably larger than the energy of an atom in the liquid. It is shown that low temperature films of helium will correspond to this model, rather than the model leading to the B.E.T. equation. It follows that the "anomalous" adsorption properties of helium have been inferred from unreal parameters which are a result of the application of the B.E.T. theory. An alternate method of analysis based on a more realistic model is proposed. When a typical case is treated in this manner, reasonable values for the parameters in question result. A.

541.183.5

2783. ADSORPTION OF OXYGEN ON ZINC OXIDE. S.R.Morrison and P.H.Miller, Jr.
J. chem. Phys., Vol. 25, No. 5, 1064-5 (Nov., 1956).

In studies of the electrical characteristics of zinc oxide, it has been suggested that adsorbed oxygen plays an important role in determining the electrical conductivity of the material. Further studies of the photoconductivity by Melnick have also indicated the presence of adsorbed oxygen on zinc oxide. As a check that the interpretation of the electrical characteristics is reasonable, some rough volumetric measurements of the adsorption of oxygen have been made and are reported. A.

CHEMICAL STRUCTURE 541.2/.6

541.5

2784. ELECTROSTATIC INTERPRETATION OF DIRECTED VALENCE. B.F.Gray and H.O.Pritchard.
J. chem. Phys., Vol. 25, No. 4, 779-80 (Oct., 1956).

Discusses directed valence in terms of the balance between the electrostatic repulsion of the nuclei and the electron—nuclear attraction, illustrating with comparisons of different compounds MH_n.
J.Hawgood

541.57

2785. MODIFICATION OF THE VECTOR MODEL TO INCLUDE A FIRST-ORDER NONORTHOGONALITY CORRECTION. W.T.Simpson.
J. chem. Phys., Vol. 25, No. 6, 1124-7 (Dec., 1956).

When the vector model is used to describe bonding it appears that the orbitals participating in bond formation are required to be orthogonal. The success of the model on an empirical basis is puzzling because chemical bonding will not occur without overlap. In the present work the many-electron functions, consisting of products of appropriately overlapping ordinary atomic orbitals, are orthogonalized. The characteristic simple form of the model is then retained provided that the exchange integral is replaced by a corrected exchange integral called a bond integral. The success of the model becomes less puzzling because this integral is usually evaluated empirically. The nature of the bond integral is examined in the framework of the Heitler—London treatment of the hydrogen molecule. A.

541.64 : 535.43

2786. INVESTIGATION OF THE SCATTERING OF LIGHT IN MIXTURES OF HIGH POLYMERS. S.S.Voyutskiĭ, A.D.Zaĭonchkovskiĭ, V.A.Kargin and R.A.Reznikova.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 6, 1093-6 (1954). In Russian.

From studies of the scattering of light by unstretched and stretched films, and of the effect of stretching of the films on their density, it is concluded that when fairly rigid polymer films are stretched, regions of lowered density or even voids may be formed due to the unequal distribution of stresses in the films, and that in polymers which are single-phase systems to all outward appearance, heterogeneities may form considerably larger than those to be found in low-molecular substances. R.C.Murray

541.65

2787. REFRACTOMETRIC AND GRAVIMETRIC STUDY OF PERCHLORETHYLENE. A.Charru.
J. Phys. Radium, Vol. 17, No. 6, 4S-5S (June, 1956). In French.

Electromagnetic theory shows that when the refractive index (n) is determined by a single distant absorption band, $\lambda^2(n^2 + 2)/(n^2 - 1)$ should be proportional to $(\lambda^2 - \lambda_1^2)/d$, where d is the specific gravity and λ_1 is the wavelength of the "reduced" band. The relation is confirmed for λ = 3650-5780 A, d being varied by varying the temperature from -1.5°C to $+84^\circ$C. G.F.Lothian

541.65

2788. REFRACTOMETRIC STUDY, IN THE VISIBLE AND ULTRAVIOLET OF SOME ALIPHATIC ALCOHOLS. J. Duroux.
J. Phys. Radium, Vol. 17, No. 6, 6S-8S (June, 1956). In French.

The equation of the previous paper (see preceding abstract) is confirmed under similar conditions for six alcohols; it is just as satisfactory as a two-constant formula proposed by Beynon (Phil. Mag., Vol. 31, No. 5, 1-12, Jan., 1941) for propyl alcohol.
G.F.Lothian

541.67 : 537.521.6

ELECTRIC STRENGTH OF SATURATED HYDROCARBON GASES. See Abstr. 2266

CHEMICAL ANALYSIS 543/545

545.3

2789. AN INSTRUMENT FOR THE MEASUREMENT OF SALINITY IN ESTUARIES. E.G.Sandels.
J. sci. Instrum., Vol. 33, No. 11, 424–8 (Nov., 1956).

The instrument described is carried in a boat, water being pumped through it from an intake which is lowered into the estuary. Electrical conductivity and temperature are measured and the salinity is computed readily from a nomogram. Radiofrequency circuits are employed for the measurements, the indicator being a milliammeter operated from a d.c. amplifier. The accuracy is better than ±⅓ parts per thousand over a salinity range of from 0.2 to 50 p.p.t. A.

CRYSTALLOGRAPHY 548

548.0 : 536.21 : 536.413

2790. ON THE THERMAL EXPANSION AND THERMAL CONDUCTIVITY OF SOME CRYSTALS. T.A.Kontorova.
Zh. tekh. Fiz., Vol. 26, No. 9, 2021-31 (1956). In Russian.

In this paper data for 11 alkali halides are compiled, from which properties of the crystal lattices are determined. Approximate theoretical relations are discussed from which the thermal expansion coefficient can be derived and which determine the thermal conductivity apart from a numerical factor. Whereas there is no direct comparison of calculated and observed values of these two physical constants, it is shown that theory and experiment are compatible. R.Eisenschitz

548.5 : 539.42

2791. SOME OBSERVATIONS ON THE SOLID STATE OF ARGON. D.Stansfield.
Phil. Mag. (Eighth Ser.), Vol. 1, 934-7 (Oct., 1956).

A polycrystalline specimen of solid argon has been grown using a modification of Bridgman's method; grains of up to 4 mm diameter have been produced. A technique was used to etch the specimen thermally, and the results on structure and grain boundaries are described. Preliminary values of mechanical properties are also given. A.

548.52

2792. THE EVAPORATION OF IMPURITIES FROM SILICON. S.E.Bradshaw and A.I.Mlavsky.
J. Electronics, Vol. 2, No. 2, 134-44 (Sept., 1956).

It is shown that the concentration of impurity in a silicon crystal grown in a vacuum is governed by the rate of evaporation and the growth conditions. Three cases of practical interest are distinguished: (i) When evaporation of volatile impurities from the melt is substantially complete before growth of the crystal is begun, boron and aluminium are the only residual impurities from groups III and V. (ii) An added impurity, such as phosphorus, is distributed uniformly in a crystal when the growth time, from the moment of addition, has a critical value. (iii) Repeated addition of an impurity, such as antimony, to a melt containing an impurity of opposite type, produces a series of identical p–n junctions in the growing crystal, the type of junction produced being controlled by the growth conditions employed. Equations describing the combined effects of evaporation and segregation are derived, and the rates of evaporation of certain impurities calculated. A.

548.52

2793. ON THE GROWTH OF THIN KCl LAYERS ON SINGLE CRYSTAL SUBSTRATES (ELECTRON MICROSCOPE OBSERVATIONS). D.Sönksen.
Z. Naturforsch., Vol. 11a, No. 8, 646-9 (Aug., 1956). In German.

KCl layers in the thickness range 200 to 20 000 A were evaporated in a $3 - 5 \times 10^{-5}$ mm Hg vacuum onto freshly cleaved KCl surfaces at room temperature. The size of the crystallites and their orientations were examined in an electron microscope. In general smooth layers were observed but a certain amount of "seeding" occurred due to the presence of small amounts of impurity which acted so as to lock the dislocations and aid in the crystal growth. C.A.Hogarth

548.53 : 548.7 : 669.04

2794. ZONE-MELTING PROCESSES FOR PURE COMPOUNDS AB WITH A NEGLIGIBLE VAPOUR PRESSURE. J.van den Boomgaard.
Philips Res. Rep., Vol. 11, No. 1, 27-44 (Feb., 1956).

The composition of a pure compound AB generally will change if zone-melting processes are applied to it. In the present paper, the theory for this case is developed under the assumption that reactions with the vapour may be neglected, i.e. the compound has no measurable vapour pressure. With a few general assumptions, which will be clarified by a model describing the solid and the liquid state of binary semiconductors in terms of vacancies, it is possible to define the distribution equilibria with two distribution constants and to derive mathematical expressions for the deviation from the stoichiometric composition as a function of the place in the rod. A.

548.53 : 548.7 : 669.04

2795. ZONE-MELTING PROCESSES FOR COMPOUNDS AB WITH A MEASURABLE VAPOUR PRESSURE UNDER INFLUENCE OF THE ATMOSPHERE. J.van den Boomgaard.
Philips Res. Rep., Vol. 11, No. 2, 91-102 (April, 1956).

Zone melting of compounds AB, in which deviations from the exact stoichiometric composition may occur and which have a measurable vapour pressure at the melting point, is possible if a vapour pressure of one of the components is applied to prevent the decomposition of the material. If the liquid AB is described in a semi-crystalline way with two kinds of coupled defects, which are in equilibrium with two kinds of coupled defects in the solid, it is possible to describe the distribution equilibrium and the reaction with the gas phase in terms of these defects. With this model, it is possible to derive some mathematical expressions for the relation between the deviation from the exact stoichiometric composition and the position in the rod of AB, as a result of zone-melting processes. A.

ATOMIC AND X-RAY CRYSTALLOGRAPHY 548.7

548.7

2796. OPTIMUM ATOMIC SHAPE FOR BERTAUT SERIES. R.E.Jones and D.H.Templeton.
J. chem. Phys., Vol. 25, No. 5, 1062-3 (Nov., 1956).

Calculations are made of the error in the Madelung constant when computed by Bertaut's method with a finite number of terms and with various shapes for the charge distribution within the atoms. A charge density which is proportional to the distance from the edge of the spherical atom gives most rapid convergence for the range of accuracy 1% to 0.003%. For higher accuracy a better shape is charge density proportional to the square of the distance from the edge. If Gaussian atoms are used and overlap neglected, no choice of parameter allows an accuracy for a given number of terms as great as for the above functions. If the overlap effect is included by a second series (double series of Ewald), the convergence can be made more rapid than for any of the single series methods, but at the price of a more complicated programme. A.

548.7 : 536.631

2797. LATTICE VIBRATIONS AND SPECIFIC HEAT OF GRAPHITE. G.R.Baldock.
Phil. Mag. (Eighth Ser.), Vol. 1, 789-802 (Sept., 1956).

The vibrations of the graphite lattice can be treated approximately by ignoring the interaction between displacements parallel and perpendicular to the layer planes. The normal modes then separate into two types, which may be called planar and transverse. The complete frequency distribution of the transverse modes is calculated, and, with the aid of an approximate calculation of the distribution of the planar modes, the specific heat is deduced and compared with experimental results from 1.5° to 1000°K. Above 200° the atomic model gives results close to those obtained by super-

imposing two Debye two-dimensional continuum models, but below 100° the interaction between layers becomes important. Below 20°, the transverse modes are dominant, and the result is very sensitive to the coefficient of interaction between second neighbours in the layer. This coefficient is close to a critical value which it would attain if the transverse restoring forces on the atoms of a single layer could be considered as acting only against out-of-plane bending of the bonds. It is shown that for any two-dimensional crystal the spectrum of the transverse vibrations is anomalous at low frequencies whenever the potential energy function satisfies certain conditions, and that these conditions are satisfied if the function is independent of any uniform small rotation of the crystal. A.
548.7

2798. CRITICAL POINTS AND LATTICE VIBRATION SPECTRA. J.C.Phillips.
Phys. Rev., Vol. 104, No. 5, 1263-77 (Dec. 1, 1956).

A method is developed for obtaining directly from group-theoretical and topological considerations a consistent set of critical points belonging to a given secular equation. The treatment includes a detailed discussion of nonanalytic behaviour near degeneracies. Comparison with many specific calculations shows that the minimal set so obtained is often the set actually present in the case of short-range forces. The contributions of nonanalytic critical points to the frequency distribution are analysed. Behaviour near critical points is made the basis of a scheme for calculating the main features of frequency distributions from the corresponding minimal sets. An approximate frequency distribution is calculated for aluminium. Possible applications to energy bands are discussed. A.
548.7

2799. SCATTERING OF ELECTRONS BY LATTICE VIBRATIONS IN NONPOLAR CRYSTALS. W.A.Harrison.
Phys. Rev., Vol. 104, No. 5, 1281-90 (Dec. 1, 1956).

A theoretical analysis is made which permits an estimate of the relative importance of acoustical-mode and optical-mode scattering in monatomic nonmetals. This comparison is achieved by expanding the matrix elements for scattering in powers of the electron wave number. Individual terms are examined in the light of crystal symmetries and the nature of the band minimum associated with the carriers. The order of the first nonvanishing term is obtained in each case. The temperature dependence of the mobility as indicated by these results is compared with that observed in the cases of electrons and holes in silicon and germanium. The observed dependence upon temperature is understandable in terms of the expected relative importance of acoustical- and optical-mode scattering in the cases of holes in silicon and germanium and electrons in germanium. In the case of electrons in silicon, optical modes are not expected to contribute appreciably and the strong temperature dependence must arise from some other mechanism, presumably intervalley scattering. The relation between the results obtained here and those of deformation-potential theory is discussed briefly. A.
548.7

2800. THE VIBRATIONAL FREQUENCY DISTRIBUTION OF GRAPHITE. I. OUT-OF-PLANE MODES OF A SINGLE LAYER. P.B.Sherry and C.A.Coulson.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1326-30 (Dec., 1956).

Using a potential energy function derived from molecular spectra to describe the out-of-plane vibrations of a graphite crystal, the distribution function for these vibrations is calculated for an infinite, single layer. This distribution function is different from certain other calculated distributions which use other types of potential energy function. The reason for this difference is analysed, and application is made to the contribution of these modes of vibration to the specific heat of graphite. A.
548.7

2801. THE NUCLEAR MAGNETIC RESONANCE SPECTRUM OF Na^{23} IN $NaH_2PO_4.2H_2O$. F.Holuj and H.E.Petch.
Canad. J. Phys., Vol. 34, No. 11, 1169-70 (Nov., 1956).

The n.m.r. spectrum of Na^{23} of a single crystal of $NaH_2PO_4.2H_2O$ is centred at 5.538 Mc/s with H_0 = 5800 gauss. The quadrupole fine structure as a function of crystal orientation indicates 4 Na atoms in a unit cell with electric field gradient tensors identical in magnitude and related in direction by 3 twofold rotation axes parallel to the crystal axes. The coupling parameter is 1178.6 ± 0.5 kc/s and the asymmetry parameter 0.467 ± 0.002; these values indicate ionic bonds. D.H.Whiffen
548.7

2802. ON NUCLEAR MAGNETIC RELAXATION IN IONIC CRYSTALS. G.R.Khutsishvili.
Zh.éksper. teor. Fiz., Vol. 31, No. 3(9), 424-6 (1956). In Russian.

Discusses two mechanisms of relaxation of nuclei in ionic crystals: (1) If the nuclei possess a quadrupole moment then $T_1 = (C_1/\omega_m)(Mv^2/b)^2(\theta/T)^4$ when $T > \theta$, and $T_1 = (C_2/\omega_m)(Mv^2/b)^2 \times (\theta/T)^7$ when $T \ll \theta$, where $b \sim e^2Q/a^3$. In these expressions M = nuclear mass, v = propagation velocity of elastic waves, θ = Debye temperature, a = interionic distance, ω_m = maximum frequency of acoustic waves, and the C_1 and C_2 are undetermined numerical coefficients. (2) If N paramagnetic ions per unit volume are present then in general $T_1 = 1/(4\pi DcN)$, where D = the coefficient of nuclear spin diffusion and $c = 0.68\,\beta^{1/4}$, where $\beta = (\gamma\gamma'\hbar)^2S(S+1)/(5\pi\rho\nu^2)$ with ν = the nuclear resonance frequency, and ρ = the time of paramagnetic relaxation. All the formulae are in semiquantitative agreement with experiments. D.H.Whiffen
548.7

2803. NUCLEAR QUADRUPOLE INTERACTIONS IN TWO TUTTON'S SALTS. R.F.Kiddle and W.G.Proctor.
Phys. Rev., Vol. 104, No. 4, 932-6 (Nov. 15, 1956).

Reports results of nuclear induction experiments on two isomorphic crystals of Tutton's salts, $Rb_2Mg(SO_4)_2.6H_2O$ and $Cs_2Mg(SO_4)_2.6H_2O$, belonging to crystal class $P2_1/a$. The splittings, due to nuclear electric quadrupole interactions, of the nuclear magnetic resonance spectra of Rb^{87} and Cs^{133} observed in these experiments are analysed by using perturbation theory. Analysis of the data yields a quadrupole coupling constant for Rb^{87} of $|eQq/h| = 3141 \pm 35$ kc/s, and the asymmetry of the field gradient at the nuclear site is $\eta = (\phi_{xx} - \phi_{yy})/\phi_{zz} = 0.47 \pm 0.01$. The principal axis of the field gradient is directed toward the nearest sulphate ion but no correlation of asymmetry and near neighbour locations is observed. Comparison of the magnitudes of the field gradient at the nuclear sites of Rb and Cs were obtained by comparing the observed line patterns for the symmetry axis rotations, using the known moments of Cs and Rb. The complexity of the Cs spectra precluded a more complete comparison of the electric field symmetry. A.
548.7

2804. DEPENDENCE OF THE PURE QUADRUPOLE RESONANCE FREQUENCY ON PRESSURE AND TEMPERATURE. T.Kushida, G.B.Benedek and N.Bloembergen.
Phys. Rev., Vol. 104, No. 5, 1364-77 (Dec. 1, 1956).

Measurements of the pure quadrupole resonance frequency (ν) of the Cu^{63} nucleus in cuprous oxide, and the Cl^{35} nucleus in potassium chlorate and paradichlorobenzene have been made as a function of pressure in the range 1 to 10 000 kg/cm² for temperatures between −77° C and 100° C. A theory is presented in which the static value of the electric field gradient tensor (ϕ_{ij}^0) and the amplitudes ξ_i^0 of the normal modes of the lattice vibrations play a central role. The volume dependence of these quantities can be deduced from ν-versus-volume isotherms which are constructed from the experimental data by using the equation of state. Information on the latter is augmented by theory. It is found that the temperature variation of the resonance frequency at atmospheric pressure can be understood by considering not only the explicit temperature dependence of the vibration amplitudes, but also by including the appreciable effects of the volume expansion on q_0 and ξ_i^0. Furthermore, the pressure dependence is found to be explicable in terms of the volume dependence of q_0 and ξ_i^0. In Cu_2O, it is found that q_0 depends on volume roughly as V^{-1}, thereby indicating an ionic character for this crystal. On the other hand, in paradichlorobenzene, $q_0 \propto V^n$, with $0 < n < 0.04$, thus exhibiting the effect of an increase in the intermolecular hybridization of the C–Cl covalent bond. A.
548.7

2805. ULTRASONIC EXCITATION OF NUCLEAR MAGNETIC ENERGY LEVELS OF Na^{23} IN NaCl. W.G.Proctor and W.A.Robinson.
Phys. Rev., Vol. 104, No. 5, 1344-52 (Dec. 1, 1956).

The nuclear magnetic levels of Na^{23} in a single crystal of NaCl placed in a strong magnetic field have been saturated by the pure quadrupole transition $\Delta m = 2$, caused by ultrasonic excitation. The observed transition rate has been compared with theoretical expressions to find that the electric field gradient generated at the nuclear site by the lattice distortion is very close to that expected from a simple classical model. Hence the large covalent and antishielding factor required to explain the spin–lattice relaxation time on the basis of the theory of Van Kranendonk is not found. Possible reasons for this discrepancy are discussed. A.
548.7

2806. MAGNETIC RESONANCE IN MANGANESE FLUORIDE. B.Bleaney.
Phys. Rev., Vol. 104, No. 4, 1190-1 (Nov. 15, 1956).

Explains how the large shift of F resonance in MnF_2 (Abstr. 858/

1957). for which $\alpha = 0.0776$ in the ab plane, can be predicted from the susceptibility and the hyperfine coupling for the electron resonance (Abstr. 8312-3/1956) for Mn^{++} in ZnF_2 from which $\alpha = 0.077 \pm 0.006$. In the antiferromagnetic state of MnF_2 the F resonance disappears, but a transition frequency of 179 ± 2 Mc/s should be present at zero field this being the F transition frequency in the field of the Mn^{++} which is parallel to the c axis. D.H.Whiffen

548.7

2807. PARAMAGNETIC RESONANCE OF LATTICE DEFECTS IN IRRADIATED QUARTZ. R.A.Weeks.
J. appl. Phys., Vol. 27, No. 11, 1376-81 (Nov., 1956).

Various kinds of silica glass and natural and synthetic crystals have been irradiated with fast neutrons at temperatures of $\sim 250^\circ$ C and above 300° C. In the glasses, asymmetric paramagnetic resonance lines resulting from the irradiation have been observed with apparent g values of 2.0013 ± 0.0006 and 2.0090 ± 0.0007, and half-widths of $\cong 1.7$ gauss and $\cong 40$ gauss, respectively. Two groups of lines were found in the natural crystals and have been associated with the two lines in the glasses, the two lines in the glasses being the envelope of the lines in the crystals when they are summed over random orientations with respect to the magnetic field. On the basis of g values, absence of common impurity and of hyperfine splitting, and the thermal stability of the lines, it is concluded that the observed resonances in the silica glasses and crystals have their origin in defects in the basic SiO_4 tetrahedra generated by fast neutrons and primary and secondary knockons. From preliminary optical bleaching data in neutron irradiated Corning silica it is tentatively concluded that the resonance with $g = 2.0013$ is associated with the defect which gives rise to an optical absorption band at 2120 A. The g values of the two lines in the silica glasses suggest that one centre is an electron and the other a hole. A.

548.7

2808. PARAMAGNETIC RESONANCE INVESTIGATION OF IRRADIATED KCl CRYSTALS CONTAINING U-CENTERS.
C.J.Delbecq, B.Smaller and P.H.Yuster.
Phys. Rev., Vol. 104, No. 3, 599-604 (Nov. 1, 1956).

The effects of ultraviolet irradiation of KCl—KH and KCl—KD single crystals at 80°K and 300°K have been investigated using paramagnetic resonance and optical absorption techniques. KCl—KH crystals irradiated at 80°K have been found to exhibit, along with the usual F-centre spin resonance, a resonance doublet with a splitting of 500 ± 10 gauss and a line width of 68 ± 5 gauss; the doublet is presumed to be due to hydrogen atoms in the crystal. This conclusion is substantiated by the fact that KCl—KD crystals, after a similar irradiation, exhibit a resonance triplet with a separation of outer components of 156 ± 10 gauss. Further results lead to the following conclusions: (1) that the hydrogen atoms produced by irradiation are located in interstitial positions in the lattice, (2) that these interstitial hydrogen atoms give rise to an optical absorption band (U_2-band) located at 236 mμ, (3) that a broad optical absorption band (U_1-band) extending to the long wavelength side of the U-band is due to interstitial hydride ions. A.

548.7

2809. THE PARAMAGNETIC RESONANCE SPECTRUM OF Fe^{3+} IN THE CUBIC FIELD OF MgO. W. Low.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1169-70 (Nov., 1956).

The electron resonance spectrum of Fe^{+++} in MgO is observed at 1.2 cm and liquid He temperatures. The $^6S_{5/2}$ ground state is split by the cubic field to a 2- and a 4-fold degenerate states with a separation $3a = +615 \times 10^{-4}$ cm^{-1}; $g = 2.0037 \pm 0.0007$. The fact that the spectrum is cubic shows that the trivalent ion is not associated with vacancies in the lattice caused by replacing the divalent Mg. D.H.Whiffen

548.7

2810. EFFECT OF THE ELECTRON–LATTICE INTERACTION ON PHONON FREQUENCIES. P.G.Harper.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1095-100 (Nov., 1956).

The interaction of free electrons with the lattice vibrations is treated, allowing only the virtual excitations of a single electron–hole pair to contribute to the phonon energy. Changes in sound velocity for the Fermi and Fröhlich states are compared. A.

548.7

2811. THE FORM OF THE EFFECTIVE ELECTRONIC POTENTIAL IN A CRYSTAL. G.G.Hall.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1124-32 (Nov., 1956).

The equations for the best single-electron orbitals in a crystal are interpreted in terms of an effective potential and the various contributions to this potential are considered. The exchange terms are important and act like an attractive potential which moves through the crystal. The form of this attraction changes abruptly and its magnitude decreases greatly on passing from orbitals arising from the valence shell to higher orbitals. An approximate form for the exchange potential, suggested recently by Slater, is critized in the light of these results. A.

548.7

2812. RELAXATION BETWEEN ELECTRONS AND THE CRYSTAL LATTICE. M.I.Kaganov, I.M.Lifshits and L.V.Tanatarov.
Zh. éksper. teor. Fiz., Vol. 31, No. 2(8), 232-7 (1956). In Russian.

The relaxation between the electrons of a metal and the crystal lattice (phonons) is examined. The state of the electrons and lattice is described by equilibrium Fermi and Bose functions at different temperatures. The heat transfer coefficient related to "Cherenkov radiation" of sound waves by the electrons has been determined. A.

548.7

2813. THEORY OF LOCAL STATES OF AN ELECTRON IN AN ISOTROPIC HOMOPOLAR CRYSTAL. M.F.Deĭgen.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 504-11 (1956). In Russian.

The behaviour of an electron localized around a defect in a non-metallic homopolar crystal is examined with account of "condensed" interaction between the electron and the crystal. The energy terms of the system and the electron thermal dissociation energy are computed by considering the electron motion quantum-mechanically and the motion of the lattice atoms quantum-mechanically and classically. It is shown that due to condensed interaction the electron thermal dissociation energy and the photodissociation energy are different. The parameters of the light absorption band of a localized electron (position of the maximum, the half-width and the temperature dependence) are determined. As an example, numerical calculations for a Coulomb defect potential (e.g., that of an admixture atom with a valence electron) are presented. A.

548.7

2814. EMISSION SPECTRUM OF AN EXCITON. E.F.Gross and M.A.Yakobson.
Zh. tekh. Fiz., Vol. 26, No. 6, 1369-71 (1956). In Russian.

The observation of an exciton excitation spectrum in Cu_2O (Abstr. 3312/1954) inspired the authors to look for a corresponding emission spectrum. Their attempt was unsuccessful. Later experiments with CdS at 77°K, however, did show an emission spectrum in the region 4800 to 5010 Å. It is concluded that the blue luminescence observed in CdS is due to emission occurring on the annihilation of excitons. A similar result has been obtained in crystals of $Hg I_2$ (Abstr. 8804/1956). J.B.Arthur

548.7

2815. THE ABSORPTION AND EMISSION SPECTRA OF EXCITONS IN THE CdSe CRYSTAL. E.F.Gross and V.V.Sobolev.
Zh. tekh. Fiz., Vol. 26, No. 7, 1622-4 (1956). In Russian.

Absorption and luminescence spectra were measured in thin slabs (10 to 30μ) of single crystal CdSe. As for CdS (see preceding abstract) a number of well-defined lines and bands were found, at 4.2°K, near the main absorption edge (6653 to 6800 A). Luminescence bands were found, at 77.3°K, in the region 6806 to 7458°A some of which could be identified with corresponding absorption bands, suggesting the creation and annihilation of excitons. J.B.Arthur

548.7 : 538.652

2816. LATTICE MAGNETOSTRICTION IN SPINEL-TYPE IRON CHROMITES. M.H.Francombe and H.P.Rooksby.
Nature (London), Vol. 178, 586-7 (Sept. 15, 1956).

Measurements of the lattice distortion as iron chromites of composition $FeFe_{(2-x)}Cr_xO_4$ are cooled through their paramagnetic—antiferromagnetic transition temperatures show that the dilation effect is greater for $x = 1.2$ than for $x = 1.0$, and that for $x = 2.0$ it is greater still but in the opposite sense. A.E.De Barr

548.7

2817. COPPER PRECIPITATION ON DISLOCATIONS IN SILICON. W.C.Dash.
J. appl. Phys., Vol. 27, No. 10, 1193-5 (Oct., 1956).

Precipitates formed by copper diffused into silicon crystals were studied by optical means using an infrared image tube. Linear aggregates are identified as dislocations by correlation with etch pits. Dislocations in as-grown crystals are usually curvilinear. Dislocation loops formed during plastic deformation consist of straight-line composite portions and pure screw portions, all of which lie in $\langle 110 \rangle$ directions. Precipitates frequently are not found on screw dislocations; when present they differ in detail from those on composite. Interactions between adjacent dislocations can be seen. Etch pits

associated with either composite or screw dislocations are similar in form, indicating that the pits formed in as-grown crystals by the technique described identify all the dislocations. Dislocation loops enter from the surface upon deformation of crystals with relatively few grown-in dislocations. Dislocation loops formed entirely within the crystal in patterns consistent with operation of the Frank—Read mechanism are observed in less perfect crystals. A.

548.7

2818. SYMBOLS FOR LATTICE DISORDERS. F.Körösy.
Nature (London), Vol. 178, 1341-2 (Dec. 15, 1956).

Suggests the desirability of settling a notation for crystal lattice defects and suggests a number of acceptable alternatives.

A.B.Lidiard

548.7

2819. DIRECT OBSERVATIONS OF THE ARRANGEMENT AND MOTION OF DISLOCATIONS IN ALUMINIUM. P.B.Hirsch, R.W.Horne and M.J.Whelan.
Phil. Mag. (Eighth Ser.), Vol. 1, No. 7, 677-4 (July, 1956).

Electron optical experiments on Al foils have revealed individual dislocations in the interior of the metal. The arrangement and movement of individual dislocations have been observed. Most of the dislocations occur in the boundaries of a substructure, the diameter of the subgrains being of the order of 1 μ or more. Tilt-boundaries, networks and dislocation nodes have been resolved. The results apply to aluminium recovered at 350° C after heavy deformation by beating; the dislocation density is $10^{10}/cm^2$. The dislocations can be seen to move along traces of (111) slip planes; the motion of the dislocations can be either rapid or slow and jerky. Cross-slip by the screw dislocation mechanism has been observed frequently. A.

548.7

2820. ETCHPITS AND DISLOCATIONS IN ZINC SINGLE CRYSTALS. A.H.A.Méléka.
Phil. Mag. (Eighth Ser.), Vol. 1, 803-11 (Sept., 1956).

The object of this work was to obtain information on the possibility of indexing dislocations by the presence of etchpits. High-purity zinc single crystals have been etched in 0.1% iodine in alcohol and the distribution of the etchpits was studied. This agreed with the theoretical calculations based on the interaction of dislocations, provided every etchpit is taken to represent the site of a single dislocation of unit strength. A.

548.7 : 537.311.31

2821. QUENCHING VACANCIES IN PLATINUM. F.J.Bradshaw and S.Pearson.
Phil. Mag. (Eighth Ser.), Vol. 1, 812-20 (Sept., 1956).

The electrical resistance of platinum wires was measured in liquid nitrogen before and after heating to high temperatures and quenching to room temperatures. It was found that the resistance after quenching was greater than its original value but that the increase could be removed by annealing at temperatures in the region of 400° C. This annealable increase is interpreted as being due to lattice vacancies. The whole annealing process was governed by an activation energy of 1.1 eV and this energy is considered to be that for movement of a single vacancy. It is deduced that a vacancy made on average 10^9 jumps before disappearing. The annealing results are used to show that in certain cases quenching was fast enough to retain the high-temperature equilibrium concentration of vacancies. Hence the variation of increase of resistance on quenching with initial temperature is used to deduce an energy of 1.4 eV for forming a vacancy. The entropy factor required does not disagree with theory. A.

548.7

2822. THE SELF-ENERGY AND INTERACTION ENERGY OF STACKING FAULTS IN METALS. R.W.Attree and J.S.Plaskett.
Phil. Mag. (Eighth Ser.), Vol. 1, 885-911 (Oct., 1956).

A model is considered of a crystal lattice having slip of less than a lattice vector on two close packed planes. The effect of this slip on the eigenvalues of one electron wave-functions extending throughout the crystal is calculated, using first-order perturbation theory to give the wave-functions in a perfect crystal. The self-energy of a fault in a monovalent metal is found to be about 20 $ergs/cm^2$. The interaction energy is found to be about 0.4 $ergs/cm^2$ when the faults are one lattice plane apart and negligible when they are further apart. An unsuccessful attempt is made to calculate the effect of electrons with wave vectors near zone faces. The theory involved a clarification of the Bloch—Floquet theory and the use of a contour integral to sum the zeros of an exponential sum. A.

548.7

2823. CONTINUOUS DISTRIBUTIONS OF DISLOCATIONS: SURFACE DISLOCATIONS AND THE CRYSTALLOGRAPHY OF MARTENSITIC TRANSFORMATIONS. R.Bullough and B.A.Bilby.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1276-86 (Dec., 1956).

Some results of the theory of plane surface dislocations required for the analysis of martensite crystallography are derived. In their subsequent application, the surface dislocation forming the boundary between the phases is assumed to correspond to one parallel array of like dislocations of arbitrary Burgers vector moving in an arbitrary plane, and the Burgers vector and plane are assumed given. It is also assumed that the relative pure lattice strain of the phases is quite general, and given. Using these data, the theory is applied to deduce the habit plane, shape deformation and orientation relationship occurring. The relative shape deformation is an invariant plane strain. The method enables the effect of different assumptions about the Burgers vector, plane of motion, and lattice pure strain to be easily examined. The method is compared with other treatments to which it is essentially equivalent. The use of the surface dislocation theory, however, simplifies some of the analysis. The relation of the method to analyses assuming a finely twinned product is also discussed. A.

548.7 : 537.311.33

2824. FORMATION OF CRYSTALLINE LATTICE DEFECTS IN GERMANIUM UNDER BOMBARDMENT BY FAST ELECTRONS. V.S.Vavilov, L.S.Smirnov, G.N.Galkin, A.V.Spitsyn and V.M.Patskevich.
Zh. tekh. Fiz., Vol. 26, No. 9, 1865-9 (1956). In Russian.

Thin specimens of n-type Ge were bombarded, at room temperature, with 400 to 1000 keV electrons. The observed decreases in conductivity were used to calculate the dependence of the defect deformation cross-section on electron energy. A sharp threshold was observed at 500 keV, below which the electrons were ineffective. The experimental points lay on a theoretical curve based on Mott's formula (Proc. Roy. Soc. A, Vol. 124, 429, 1929) suggesting that to each defect there corresponds one effective acceptor level.

J.B.Arthur

548.7

2825. THE INFLUENCE OF AN ELECTRIC FIELD ON THE ADDITIVE COLOURING OF ROCK SALT CRYSTALS. V.M.Yuzhakov and P.G.Delneka.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 4, 671-2 (1954). In Russian.

Metallic sodium was placed in an enclosed cavity between two blocks of NaCl. This composite crystal was fitted with electrodes for applying the field and was placed in a furnace. At 600° C, under 7 V/cm for 35 min and 70 V/cm for a few seconds, the spread of colouring was observed. Several similar trials showed that the number of colour centres is inversely proportional to the applied field. A.L.Mackay

548.7

2826. ON THE ADDITIVE COLORATION OF KBr CRYSTALS. G.Jacobs.
J. chem. Phys., Vol. 25, No. 3, 583-4 (Sept., 1956).

Crystals pretreated in vacuo are very difficult to colour by heat treatment in potassium vapour, but the presence of adsorbed oxygen or nitrogen etc., appears to facilitate the coloration. The experiments provide some explanation of previous studies of the effects of annealing on the coloration of alkali halide crystals. G.F.J.Garlick

548.7

2827. ANISOTROPIC COLOR CENTERS IN α QUARTZ. I. SMOKY QUARTZ. A.J.Cohen.
J. chem. Phys., Vol. 25, No. 5, 908-14 (Nov., 1956).

The colour centre at 460 mμ produced by X-irradiation of naturally colourless or bleached smoky quartz is anisotropic. The absorption maximum of this colour centre for the extraordinary ray is 460 mμ and for the ordinary ray is 485 mμ. A second anisotropic peak with maximum in the vicinity of 625 mμ for the extraordinary ray is also present. The relative anisotropy of these colour centres in a natural, a Bell synthetic and a Brush synthetic quartz are compared and found to be nearly identical in the case of the synthetic quartzes studied. The absorption coefficients of these colour centres X-rayed to saturation are compared with total aluminium content for five specimens. A.

548.7 : 535.371

2828. COLOR CENTERS AND LUMINESCENCE IN SINGLE CRYSTALS OF LANTHANUM TRICHLORIDE CONTAINING DIPOSITIVE EUROPIUM. D.M.Gruen, J.G.Conway and R.D.McLaughlin.

J. chem. Phys., Vol. 25, No. 6, 1102-10 (Dec., 1956).

The edge of the fundamental absorption band in pure $LaCl_3$ is at about 2250 A. There is no change in the absorption spectrum of pure $LaCl_3$ in the range 2250 to 25 000 A on exposure at room temperature to 10^7r of gamma-rays from a Co^{60} source. The crystals do not luminesce after such treatment. In contradistinction, $LaCl_3$ containing small amounts of europium exhibits a blue luminescence and thermoluminescence when exposed to ultraviolet or gamma-radiation. The luminescent properties are profoundly influenced by long continued gamma irradiation. In addition, colour centres are formed which absorb visible radiation. Chemical as well as paramagnetic resonance experiments show that all of these effects are due to the presence in the $LaCl_3$ lattice of dipositive europium. There are at least three different colour centres giving rise to three overlapping absorption bands which decay thermally with different rates. The maxima of the absorption bands are at 8000, 6500 and 5500 A. Studies with polarized light show that the colour centre transitions are all electric dipole in nature and are highly anisotropic. The most intense band has been tentatively identified with an F-centre-like $s \rightarrow p$ transition. Experiments on the thermal decay of the colour bands and the glow curve of the crystal indicate that an intimate relationship exists between the colour centre and the luminescence phenomena. It is suggested that when these crystals are irradiated, dipositive europium loses an electron to become tripositive, the electron being captured by an anion vacancy to form a colour centre. On thermal freeing of the electron, return to the ground state is accompanied by the emission of visible radiation. A.

548.7

2829. PROPOSED MECHANISM FOR THE CONVERSION OF U-CENTERS TO F-CENTERS BELOW 90°K. C.J.Delbecq and P.H.Yuster.
Phys. Rev., Vol. 104, No. 3, 605-6 (Nov. 1, 1956).

Experiments with KCl-KH single crystals suggest the following mechanism for the production of F-centres from U-centres at temperatures below 90°K. The thermal spike, produced after excitation of a U-centre, is sufficiently energetic to eject the hydride ion into an interstitial position. Excitation of an interstitial hydride ion (U_1-centre) may result in the transfer of the excited electron via a tunnelling process to a negative-ion vacancy (α-centre) forming an F-centre and an interstitial hydrogen atom. Excitation of an F-centre may reverse the latter process, also via a tunnelling process. The tunnelling probabilities for these processes vary with the tunnelling distance, and experimental results indicate the existence of four distance intervals, about an α centre, each interval being characterized by the tunnelling processes which can occur. A.

548.7

2830. DIFFERENTIAL SPUTTERING OF GRAIN BOUNDARIES IN POLYCRYSTALLINE TIN. P.G.Deo and B.D.Sharma.
Nature (London), Vol. 178, 812-13 (Oct. 13, 1956).

Differential etching in a pure specimen of tin has been observed from boundaries forming tri-crystals. The polished surface was sputtered and the dihedral angles between the tri-crystal boundaries measured. Calculation of the relative densities of dislocations shows that the most etched boundary has the highest sputtering and the highest relative density of dislocations. The results support the "transition lattice" theory of the grain boundary. J.Iball

548.7 : 538.245

2831. CHANGES IN DOMAIN STRUCTURE ACCOMPANYING REDUCTION IN DEPTH OF A SINGLE CRYSTAL OF SILICON IRON. L.F.Bates and A.Hart.
Proc. Phys. Soc. B, Vol. 69, Pt 12, 1200-4 (Dec., 1956).

Bitter patterns reveal marked changes in the domain structure of a Néel-cut crystal of silicon–iron when the crystal dimension perpendicular to a (110) plane is sufficiently reduced, and suggest the formation of a new structure with an energy comparable with that of the normal Néel type. Such changes in the domain configuration must be accompanied by corresponding changes in magnetic properties. A.

548.7

2832. METALLIC TRANSITION IN IONIC AND MOLECULAR CRYSTALS. J.Alder and R.H.Christian.
Phys. Rev., Vol. 104, No. 2, 550-1 (Oct. 15, 1956).

Experimental evidence is obtained that transitions to a metallic state occur at pressures below 25×10^4 atm, as indicated by conductivities. The pressures are produced by shock-waves from a high-explosive system as previously described. A decrease in resistance of the order of 10^6 is measured. J.Jacobs

548.7 : 537.226.2

EFFECT OF THE NaCl CRYSTAL IMPERFECTIONS ON THE DIELECTRIC CONSTANT. See Abstr. 2169

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73 : 539.213

2833. INFRARED SPECTROSCOPIC STUDY OF CRYSTALLINITY OF CERTAIN POLYMERS. E.I.Pokrovskiĭ and I.P.Kotova.
Zh. tekh. Fiz., Vol. 26, No. 7, 1456-60 (1956). In Russian.

Absorption spectra of polytetrafluorethylene, polychlortrifluorethylene, polyethylene terephthalate, polyisobutylene, polystyrene and polymethyl methacrylate were obtained in the range 430 to 4000 cm^{-1} at temperatures from 20°C to 400°C (or up to the polymer decomposition temperature). In polymers which vitrify there is no change in absorption spectra up to the temperature of vitrification and above that temperature the changes are very small. In polymers which crystallize there is a change in intensity of absorption bands at melting. It is possible to determine the degree of crystallinity of polymers from the absorption bands attributed to the amorphous state. J.Adam

548.733

2834. HIGH TEMPERATURE X-RAY DIFFRACTION CAMERA. A.E.Austin, N.A.Richard and C.M.Schwartz.
Rev. sci. Instrum., Vol. 27, No. 10, 860-2 (Oct., 1956).

The design specifications were as follows: (1) to permit operation at temperatures up to at least 2000°C, in a high vacuum, (2) to be able to work in controlled atmosphere at somewhat lower temperatures and (3) to permit successive exposures to the specimen held at temperature. The completed apparatus appears to meet these requirements. A.

548.733

2835. X-RAY CAMERA FOR USE WITH UNICAM S.25 OSCILLATION GONIOMETER FOR MICROBEAM APPLICATIONS. K.Drenk and R.Pepinsky.
Rev. sci. Instrum., Vol. 27, No. 10, 875-7 (Oct., 1956).

A miniature cylindrical camera of 28.6 mm diameter is described which can be fitted into the well of a standard Unicam S.25 goniometer. Dimensioned drawings of the individual parts are given. J.Iball

548.733

2836. HIGH-TEMPERATURE ADAPTER FOR X-RAY POWDER CAMERAS. J.Fridrichsons.
Rev. sci. Instrum., Vol. 27, No. 12, 1015-18 (Dec., 1956).

A unit is described, which can be attached to standard room-temperature cameras. The evacuable heater-specimen space is surrounded by a beryllium cylinder with cellophane windows and the heater, either a small, gap-divided spiral, holding the specimen capillary, or a Pt wire with coated-on specimen, can be slipped in it and rocked during exposures. Temperatures up to 1000°C can be obtained with power consumption of about 10 W. Specimen temperatures are determined from line-shifts in the pattern of added internal standard or the pattern from the platinum heater wire. A.

548.733 : 537.542

USE OF COUNTER TUBES IN X-RAY ANALYSIS. See Abstr. 2348

548.734

2837. AN EMPIRICAL SCATTERING-FACTOR CURVE FOR TIN. W.H.Baur.
Acta cryst., Vol. 9, Pt 6, 538 (June, 1956). In German.

Experimental values are given, with the values obtained from the Thomas atom and by the Pauling–Sherman (Zeitschrift für Kristallographie, Vol. 81, 1, 1932) method for comparison. A.R.Stokes

548.734

2838. INDEPENDENT MEASUREMENT OF THE ATOMIC SCATTERING FACTOR AND THE DEBYE FACTOR. B.Borie.
Acta cryst., Vol. 9, Pt 7, 617-18 (July, 1956).

Obtained from the integrated intensities of the Bragg maxima and the temperature diffuse scattering, both in absolute units. J.Adam

548.734

2839. SYMMETRY RELATIONS AMONG COEFFICIENTS OF THE ANISOTROPIC TEMPERATURE FACTOR. H.A.Levy.
Acta cryst., Vol. 9, Pt 8, 679 (Aug., 1956).

Rules are derived which are applicable to any type of position in any space group. J.Adam

548.734.5

2840. PRECISION MEASUREMENT OF LATTICE CONSTANTS WITH THE COUNTER DIFFRACTION GONIOMETER. H.Neff.
Z. angew. Phys., Vol. 8, No. 10, 505-7 (Oct., 1956). In German.

A discussion of systematic errors and their variation with the Bragg angle; with some results of the typical measurements. A.R.Stokes

548.734.8

2841. VARIATION OF EXTINCTION WITH X-RAY WAVELENGTH. A.Authier and B.E.Warren.
J. appl. Phys., Vol. 27, No. 11, 1382 (Nov., 1956).

Intensity measurements were made on the 111 line of α brass and the 110 line of α iron, with annealed filings and cold-worked filings. The extinction is plotted against the ratio (attenuation by extinction)/(attenuation by absorption). A.R.Stokes

548.735

2842. INFLUENCE OF THERMAL OSCILLATIONS AND FINITE RADIUS OF THE DIFFRACTION SPHERE ON THE ELECTRON DISTRIBUTIONS OBTAINED FROM FOURIER PROJECTIONS. F.Bertinotti and A.M.Liquori.
Ricerca sci., Vol. 26, No. 7, 2118-25 (July, 1956). In Italian.

The effects due to series termination and to thermal motion on the electron distribution of a Fourier projection have been evaluated for carbon, nitrogen and oxygen by integrating the Fourier transforms corresponding to these atoms. The possibility is gained of assigning to each atom of a structure its thermal correction from the electron distribution in the Fourier projection. A.

548.735.4

2843. ALGEBRA OF STRUCTURE FACTORS. E.F.Bertaut.
Acta cryst., Vol. 9, Pt 9, 769-70 (Sept., 1956). In French.

Examples are given of the rules which were used in compiling tables for linearization of products and powers of structure factors. (Bertaut, E.F. and Dulac, J. Tables de linearisation des produits et puissances des facteurs de structure, p. 75. Grenoble, 1955). A.R.Stokes

548.735.44

2844. AN AID FOR THE APPLICATION OF THE FOURIER TRANSFORM METHOD TO PLANAR MOLECULES. A.M.Liquori.
Acta cryst., Vol. 9, Pt 6, 535 (June, 1956).

Describes an optical projection device for facilitating the fitting of a calculated transform to an observed weighted reciprocal lattice (see Abstr. 9141/1951). A.R.Stokes

548.735.44

2845. NOTE ON THE STATISTICAL APPROACH TO THE PHASE PROBLEM. J.Gillis.
Acta cryst., Vol. 9, Pt 7, 616 (July, 1956).

Suggests a more complex expression to replace the function used by Cochran and Douglas (Abstr. 3281/1955). J.Adam

548.735.46

2846. COMMENTS ON A METHOD OF STRUCTURE DETERMINATION. J.D.Dunitz and L.E.Orgel.
Acta cryst., Vol. 9, Pt 6, 537 (June, 1956).

The function $\sum_h |F(h) \cos 2\pi h.x|$ proposed by Björnhaug and Krogh-Moe (Abstr. 816/1956) is shown to be similar to the half-scale Patterson function, and therefore not as useful as its authors have claimed. A.R.Stokes

548.735.7 : 538.245

EFFECT OF CRYSTALLITE SIZE ON COERCIVITY OF Ni AND Fe FILMS. See Abstr. 2434

548.736.1

2847. CRYSTAL STRUCTURE OF BARIUM AND EUROPIUM AT 293, 78, AND 5°K. C.S.Barrett.
J. chem. Phys., Vol. 25, No. 6, 1123-4 (Dec., 1956).

Reasons are reviewed for suspecting that it may be possible to induce phase transformations in barium and europium. X-ray diffraction patterns at 78°K and 5°K, however, revealed no transformation from the normal body-centred cubic structure; there was none, also, after cold work at 5°K. The lattice constants at 5°K are 4.551 ± 0.003 A for europium, 5.000 ± 0.002 A for barium. A.

548.736.1

2848. "MACROCRYSTALLINE" CARBON. D.E.Palin.
Nature (London), Vol. 178, 809-10 (Oct. 13, 1956).

The properties of carbon obtained by sublimation from natural graphite under high vacuum are outlined. It is harder than graphite, and gives a different X-ray powder diffraction pattern. A.R.Stokes

548.736.1

2849. CRYSTAL STRUCTURE OF HYDROGEN AND DEUTERIUM. V.S.Kogan, B.G.Lazarev and R.F.Bulatova.
Zh. éksper. teor. Fiz., Vol. 31, No. 3(9), 541 (1956). In Russian.

X-ray diagrams of solid deuterium were taken; exposures of 1-2 hours are sufficient to provide clear diffraction lines at small scattering angles; it was not possible to obtain lines at larger angles. From the results it is inferred that the crystals are tetragonal with a ratio of axes c/a = 0.94 and a spacing of a = 5.4 A. The corresponding density is 0.18 g/cm^3 differing by 10% from direct measurement. A critical survey of the published X-ray data for solid hydrogen is added. The authors note that the breadth of the interferences is large enough to invalidate previous interpretations. They took new diagrams with β-radiation filters. It is found that the structure of hydrogen is tetragonal whereas it would be hexagonal according to previous interpretations. R.Eisenschitz

548.736.3

2850. STUDY OF THE WURTZITE-TYPE BINARY COMPOUNDS. I. STRUCTURES OF ALUMINUM NITRIDE AND BERYLLIUM OXIDE. G.A.Jeffrey, G.S.Parry and R.L.Mozzi.
J. chem. Phys., Vol. 25, No. 5, 1024-31 (Nov., 1956).

The c/a ratios of the hexagonal AlN and BeO structures show that they do not have a regularly tetrahedral distribution of bonds. The structural details have been studied by X-ray analysis and are discussed in relation to the concepts of the electronegativity and electroneutrality of atoms. This gives a basis for an understanding of the distribution of the wurtzite and zinc blende lattices in the binary compounds of the group III/V and II/VI elements. A.

548.736.3

2851. AN IONIZATION [COUNTER] X-RAY INVESTIGATION OF THE STRUCTURE OF BISMUTH TELLURIDE. F.I.Vasenin and P.F.Konovalov.
Zh. tekh. Fiz., Vol. 26, No. 7, 1406-14 (1956). In Russian.

Numerous plots of X-ray reflection intensities for various Bi_2Te_3 specimens are presented. Changes in the relative intensities of certain reflections were observed with changes of (a) sign of thermoelectric power, (b) method of preparation or subsequent heat-treatment. An interpretation in terms of two modifications of Bi_2Te_3 is suggested. C.H.L.Goodman

548.737

2852. THE PRINCIPLE OF RECIPROCITY IN PROTEINS. H.Lapp.
Z. Naturforsch., Vol. 11a, No. 8, 632-46 (Aug., 1956). In German.

A theoretical discussion, using wave-mechanical methods, of the problem of the "free" water in protein crystals. The water-containing protein crystal is treated as containing layers of protein molecules with an electron "gas" in the water separating the layers. The binding energy of protein molecules due to their interaction, with the electrons in the aqueous layer, and with each other is calculated. It is claimed that the results are in accord with experimental observations. J.Iball

548.74 : 538.22

NEUTRON DIFFRACTION STUDY OF THE STRUCTURES AND MAGNETIC PROPERTIES OF MANGANESE BISMUTHIDE. See Abstr. 2410

548.74 : 538.221

MAGNETIC STRUCTURES OF THE POLYMORPHIC FORMS OF MANGANOUS SULPHIDE. See Abstr. 2423

GEOPHYSICS 55

550.382

2853. REMANENT MAGNETISM OF SOME DOLERITES, BASALTS AND VOLCANIC TUFFS FROM TASMANIA. M.Almond, J.A.Clegg and J.C.Jaeger.
Phil. Mag. (Eighth Ser.), Vol. 1, 771-82 (Aug., 1956).

Magnetic measurements have been made on a number of samples of Tasmanian dolerites, basalts, and tuffs, varying in age from the Triassic to the early Tertiary, which were obtained by diamond drill coring. The magnetic dips of all these rocks were found to be very considerably greater than the present dip in Tasmania, and this result is believed to furnish strong evidence to support the hypothesis that a relative movement has occurred between the land mass of Tasmania and the geographical poles since the early part of the Tertiary period. Magnetic reversals were found to occur over certain ranges of depth in both the dolerites and the tuffs. The possible implications of these reversals are discussed in detail. A.

550.384 : 550.93

2854. COSMIC-RAY INTENSITY AND GEOMAGNETISM. W.Elsasser, E.P.Ney and J.R.Winckler.
Nature (London), Vol. 178, 1226-7 (Dec. 1, 1956).

Discusses the relevance of the Theiliers' results (Abstr. 6913/1952) on the remanent magnetism of ancient bricks on the radiocarbon method of dating. Calculations show that an error of 240 years is probable and of 1000 years possible in the age of an object 2000 years old if the change in the earth's field are long term and not just local changes. J.M.Hough

551.16

2855. TEMPERATURES IN THE EARTH'S INTERIOR. J.J.Gilvarry.
Nature (London), Vol. 178, 1249-50 (Dec. 1, 1956).

The author has recently derived the Simon melting equation from the theory of Debye and Waller (Abstr. 4358, 4360/1956), and from this has been able to obtain the temperature–depth curve for the liquid core. Using estimates due to Bullard and Coster and Hughes for temperatures in the mantle a quartic polynomial has been constructed to represent the temperature, assuming zero gradient at the centre: $T = 0.733 + 0.750d + 0.468d^2 - 0.1148d^3 + 0.00708d^4$ where T is in 10^3 °K and d is the depth in 10^3 km. The limits of error are ±25%. J.M.Hough

551.311.123

2856. FLOW PATTERNS IN GLACIER ICE. L.E.Nielsen and F.D.Stockton.
J. appl. Phys., Vol. 27, No. 11, 1386 (Nov., 1956).

Two differential equations in a previous paper (Abstr. 4745/1956) are modified to include cases when (i) the glacier is of variable thickness, and (ii) the velocity does not vanish at the edges of the glacier. J.G.Oldroyd

551.311.123

2857. FORCES THAT MOVE A GLACIER. A.Nadai.
J. appl. Phys., Vol. 27, No. 11, 1386-7 (Nov., 1956).

A hypothetical velocity distribution in a glacier moving over a horizontal floor, proposed by Nielsen and Stockton (Abstr. 4745/1956), is shown to correspond to purely viscous flow and to involve a distribution of stress throughout the glacier which is not consistent with the supposed existence of a horizontal upper surface free from stress. The slight slope of the valley floor and the activating force of gravity cannot be ignored in a theory of glacier motion. J.G.Oldroyd

551.464

2858. ANGULAR DISTRIBUTION OF SUBMARINE DAYLIGHT IN DEEP WATER. J.Lenoble.
Nature (London), Vol. 178, 756-7 (Oct. 6, 1956).

The author's method (Abstr. 4752/1956) is used with an angular scattering function having a maximum in the forward direction. Results calculated are more satisfactory than those obtained by Poole (Sci. Proc. Roy. Dublin Soc., Vol. 24, 29, 1945) assuming isotropic scattering. G.F.Lothian

ATMOSPHERE. METEOROLOGY 551.5

551.508.19

2859. OPTICAL ASPECT SYSTEM FOR ROCKETS. J.E.Kupperian,Jr and R.W.Kreplin.
Rev. sci. Instrum., Vol. 28, No. 1, 14-19 (Jan., 1957).

A simple electro-optical aspect system for use in upper air research rockets is described. Observations of the earth's albedo or night air glow along with observations of celestial bodies provide data from which the rocket's aspect is determined. A mechanical computer is described which greatly simplified aspect data reduction. A.

551.510.41 : 537.591.1

COSMIC-RAY PRODUCTION RATE AND MEAN REMOVAL TIME OF BERYLLIUM-7 FROM THE ATMOSPHERE. See Abstr. 2371

551.510.535

2860. THE INTERPRETATION OF OBSERVATIONS OF IONOSPHERIC WINDS BY THE "FADING" METHOD. E.Harnischmacher and K.Rawer.
C.R. Acad. Sci. (Paris), Vol. 243, No. 9, 747-50 (Aug. 27, 1956). In French.

Consideration of the determination of mean velocities and directions of ionospheric movements from individual values obtained by the spaced receiver fading method. It is concluded that the legibility of the fading records is important and that the direction and velocity ought to be found simply as the median values of the individual observations. G.M.Brown

551.510.535

2861. RESULTS OF SYSTEMATIC OBSERVATIONS OF IONOSPHERIC WINDS IN THE E-REGION. E.Harnischmacher and K.Rawer.
C.R. Acad. Sci. (Paris), Vol. 243, No. 10, 782-3 (Sept. 3, 1956). In French.

The spaced receiver fading method on a frequency of 2-3 Mc/s has been used to give directions and velocities of ionospheric movements in the E-layer throughout the 24 hour day, night-time observations being limited to times when Es ionization is present. Results indicate a very systematic double rotation of the wind vector in 24 hours in winter, but only one rotation (at night) in summer. G.M.Brown

551.510.535

2862. MOTION OF SPORADIC-E PATCHES DETERMINED FROM HIGH-FREQUENCY BACKSCATTER RECORDS. C.Clark and A.M.Peterson.
Nature (London), Vol. 178, 486-7 (Sept. 1, 1956).

Results obtained at Stanford give a mean velocity of the order of 300 km/hr and a direction predominantly towards the west, with no diurnal variation. As many results as possible were confirmed by a study of fEs variations on ionograms. The speed, but not the direction, agree with results obtained by other methods. G.M.Brown

551.510.535

2863. THE MEASUREMENT OF THE ELECTRON CONTENT OF THE IONOSPHERE BY THE LUNAR RADIO ECHO METHOD. J.V.Evans.
Proc. Phys. Soc. B, Vol. 69, Pt 9, 953-5 (Sept., 1956).

Preliminary results of the determination of the total electron content of the ionosphere between 100 and 500 km near sunrise from measurements of the amount of rotation of the plane of polarization of radiowaves during their double passage between earth and moon. The values are approximately twice those determined from corresponding F2 data assuming a parabolic model. G.M.Brown

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.521.1

2864. LOW POTENTIAL SOLAR COLLECTORS. H. Masson.
J. Phys. Radium, Vol. 17, Suppl. No. 6, 108A-110A (June, 1956). In French.

Where high temperatures are unnecessary solar heat may advantageously be collected by a plane collector consisting of a flowing fluid F covered with a protective substance E(solid or liquid) the purpose of which is both to transmit to F the solar radiation received and to prevent evaporation of F. It is shown that the quantity of heat Q collected in time θ is given by $Q = D\theta(t_m - t_i)[1 - \exp(-\lambda S/D)]$, where D is the rate of flow, S the surface area exposed to the radiation, $(t_m - t_i)$ the rise in temperature, and λ the coefficient of thermal transmission of E defined as the quantity of heat per unit area and unit time which E yields to F for one degree difference in temperature between the surface layer of E exposed to the radiation and F. Different forms of collector were tested, using water for F in all cases, and results for three particular types consisting of (a) water circulating in Cu tubes, (b) water between two plane iron sheets, and (c) water flowing in the space between two welded corrugated iron sheets, are shown graphically and discussed; the values of λ deduced are 3.5, 3.1 and 2.3 x 10^4 c.g.s. units respectively.

S.Weintroub

551.521.3

2865. PHOTOMETRY OF THE SOLAR AUREOLE.
G.A.Newkirk, Jr.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1028-37 (Dec., 1956).

Equations governing the radiance of the sky at a specific wavelength and distance from the sun are stated, and graphs of the Mie scattering coefficient are presented. Observations of the angular distribution of light in the aureole from $\frac{1}{4}^\circ$ to 3° from the solar limb, and of the wavelength distribution from 4500 A to 8200 A were made with a special photographic sky photometer at altitudes from 5420 ft to 12 450 ft above sea level. The analysis of the data shows: (1) The Mie particle density decreases exponentially with altitude. (2) Most of the light in the aureole is that which has been scattered by large particles. At 12 000 ft altitude, the radiance 2° from the centre of the solar disk is six times the radiance of the Rayleigh atmosphere. (3) The relative density of large particles is greater in air masses which have been in convection over land for several days and in the air behind a warm front than in other systems. (4) An increase in the relative density of large particles seems to be encountered in the jet stream. A.

551.521.3

2866. THE SECOND PURPLE LIGHT. E.L.Deacon.
Nature (London), Vol. 178, 688 (Sept. 29, 1956).

In the light of Bigg's recent twilight observations (1956) it is concluded that the second purple light, observed $1\frac{1}{2}$ to 2 hours after sunset following major volcanic eruptions, is correctly explained by the von Helmholtz theory (1883) as being due to primary scattering of light from dust particles at heights around 70 km, thus agreeing with Bigg's computed scattering level of 81 km. D.R.Barber

551.521.3

2867. OBSERVATION OF ATMOSPHERIC SODIUM IN ABSORPTION. J.A.Scrimger and D.M.Hunten.
Nature (London), Vol. 178, 753-4 (Oct. 6, 1956).

Absorption by atmospheric Na in sunlight has been detected by a method which allows sunlight to undergo resonance scattering in Na vapour held at 150°C, the scattered radiation being subsequently analysed by a photoelectric spectrophotometer capable of resolving the two D-lines. Calibration by a tungsten source was in terms of the residual intensity of each line, expressed as a fraction of that in the adjacent continuum. By plotting logarithm of the intensity versus air-mass, and extrapolating to zero air-mass, residual intensities of 5.9 ± 0.46 per cent for D_1, and 5.06 ± 0.24 per cent for D_2 were obtained, in fair agreement with the known Fraunhofer absorptions. The effect of auto-absorption on twilight Na emission intensities in winter is to lower these by a factor of ~ 2. D.R.Barber

551.521.3

2868. DISTRIBUTION IN THE UPPER ATMOSPHERE OF SODIUM ATOMS EXCITED BY SUNLIGHT. T.M.Donahue, R.Resnick and V.R.Stull.
Phys. Rev., Vol. 104, No. 4, 873-9 (Nov. 15, 1956).

Calculation is made of the distribution of atoms excited to the $^2P_{3/2}$ state by solar radiation, direct and reflected from the earth for a model sodium layer between 70 and 100 km. Account is taken of the attenuation by resonance absorption of sunlight in the layer before the solar photons reach a given point in the layer. This absorption grossly modifies the scattered intensity at twilight, causing minima to appear at about 5° solar depression and reducing greatly the difference in scattering for thicknesses between 2 x 10^9 cm^{-2} and 2 x 10^{11} atoms/cm^2 in late twilight. The effect of imprisonment, not included, is expected to modify only the late twilight results. A.

551.557

2869. THE HEIGHT VARIATION OF UPPER ATMOSPHERIC WINDS. J.S.Greenhow and E.L.Neufeld.
Phil. Mag. (Eighth Ser.), Vol. 1, 1157-71 (Dec., 1956).

The radio echo meteor technique has been used to investigate the variation of wind velocity with altitude in the 80-100 km region. Phase changes of 5 deg km^{-1} are found in the 12 hour periodic wind and the amplitude of this component also increases by about 1 m sec^{-1} km^{-1} with height. There is also a uniform height gradient of 0.5 m sec^{-1} km^{-1} in the prevailing wind. The variations in the periodic wind are considered in relation to the theory of atmospheric oscillations. A.

551.574

2870. THE COAGULATION OF CHARGED CLOUD-DROPS. L.M.Levin.
Dokl. Akad. Nauk SSSR, Vol. 94, No. 3, pp. 467-70 (1954). In Russian.

The Langmuir and Shishkin theories of the formation of precipitates are reviewed. The author discusses two oppositely charged drops, and a large charged drop with a smaller uncharged one. It is concluded that for the charged droplets with dimensions of 4 to 30 μ the capture coefficient is quite large which ensures coagulation of the droplets. With one droplet very large, compared with another, the effect of their electric charges upon coagulation may be negligible. In rain-drop traps the precipitation on a receiver plate is almost independent of the charges on droplets and on the trap.

C.R.S.Manders

551.593 : 535.325 : 535.436

2871. TABLES OF THE REFRACTIVE INDEX FOR STANDARD AIR AND THE RAYLEIGH SCATTERING COEFFICIENT FOR THE SPECTRAL REGION BETWEEN 0.2 AND 20.0 μ AND THEIR APPLICATION TO ATMOSPHERIC OPTICS. R.Penndorf.
J. Opt. Soc. Amer., Vol. 47, No. 2, 176-82 (Feb., 1957).

The refractive index of standard air has been tabulated for the range 0.2 to 20.0 μ, namely, 0.2 (0.01) 0.8; 0.8 (0.1) 2.0; 2.0 (0.5) 10.0; 10 (1) 20 μ. The values are based on Edlén's formula. For computations of Rayleigh scattering, the scattering cross-sections, the mass and volume scattering coefficients have been tabulated for the same values of wavelength as for the refractive index. The optical thickness and the transmissivity of the standard atmosphere is given next, and finally, the mean scattering coefficient for visual observations which is $\beta_V = 1.23 \times 10^{-7}$ (cm^{-1}). A.

551.593.55

2872. A DETERMINATION OF THE LINE-WIDTH OF THE λ 6300 LINE OF OXYGEN IN THE TWILIGHT SKY. D.Q.Wark.
Nature (London), Vol. 178, 689-91 (Sept. 29, 1956).

The same Fabry—Perot interferometer as that used for the line-width determination of the 5577 A line in the night sky (Abstr. 4238/1955) was employed. Observations were made in Alaska (lat. 64° 52' N) of the twilight sky around local midnight. A mean line-width of 0.0307 ± 0.0025 A was found, corresponding to an atmospheric temperature of $750 \pm 125^\circ$ K. D.R.Barber

551.594.21

2873. THE VERTICAL DISTRIBUTION OF THE NEGATIVE CHARGE IN A THUNDERCLOUD. D.J.Malan.
Ann. Géophys., Vol. 11, No. 4, 420-6 (1955). In French.

The variation with distance is calculated of the ratio of the electrostatic field changes produced by the first and last component strokes of a multiple flash, assuming respectively a vertical and a horizontal distribution of cloud charges. The observed ratios produced by about 300 flashes involving more than 3 strokes at distances up to 150 km are tabulated and it is shown that the observations confirm the prevalence of a vertical charge column in South African clouds (Abstr. 9856/1951). From a further analysis of the field changes occurring between discrete component strokes it is concluded that they are due to the disappearance of space charge at a height above 20 km, viz. above the cloud, during a lightning discharge.

R.H.Golde

551.594.21

2874. THE LUMINOUS DISCHARGES IN THUNDERCLOUDS. D.J.Malan.
Ann. Géophys., Vol. 11, No. 4, 427-35 (1955). In French.

A simple camera is described, designed to record the variations of luminosity in a thundercloud during a lightning discharge. From

a comparison of photographic records with electrostatic field changes it is concluded that cloud–cloud and cloud–earth flashes produce continuous luminosity throughout the duration of the discharge although bursts of luminosity indicate that the charge distribution is not uniform. Records of luminosity for periods of about 100 millisec before the appearance of the first leader stroke indicate that this is often preceded by pre-discharge phenomena within the clouds. It is suggested that these pre-discharges may be due to discharges between the main negative charge centre and a small positive charge centre in the cloud base. R.H.Golde

551.594.221 : 538.08

2875. EFFECT OF LIGHTNING DISCHARGES ON MAGNETOGRAPHS. A.K.Das.
Nature (London), Vol. 178, 815 (Oct. 13, 1956).

Following an earlier report (Nature, Vol. 176, 876, Nov. 5, 1955) of "minor oscillations" recorded during a thunderstorm on a magnetograph, repeated similar disturbances were noted in records obtained in the Kodaikanal laboratory. In several cases visual correlation with lightning discharges could be established. R.H.Golde

551.594.5 : 550.385

ORIGIN OF MAGNETIC STORMS AND AURORAE. See Abstr. 1765

551.594.51

2876. MEASUREMENT OF AURORAL RADIATION 3200 Å WITH A PHOTON COUNTER (GEIGER TUBE). E.V.Ashburn.
J. atmos. terrest. Phys., Vol. 9, No. 2-3, 156-7 (Aug.-Sept., 1956).

The emission intensities of the second positive bands of N_2 at 3161 A and 3140 A in aurorae have been measured using a copper-cathode Geiger tube. Preliminary results indicate a photon count many times greater than for the airglow green line. G.M.Brown

551.594.52

2877. HEIGHT DISTRIBUTION OF AURORAL EMISSIONS. L.Harang.
J. atmos. terrest. Phys., Vol. 9, No. 2-3, 157-9 (Aug. - Sept., 1956).

The height distribution of emissions across an auroral arc have been determined by an improved photometer. The emission of the red line λ 6300 arising from $O'(D)$ atoms shows a slower decrease with height above 100 km than the other emissions, which is interpreted in terms of the increased importance of collisional deactivation for the very long life-time $O'(D)$ atoms. G.M.Brown

BIOLOGY 57/59

MEDICAL SCIENCE. HUMAN PHYSIOLOGY 61

578.087.8 : 537.542

2878. DUAL PROPORTIONAL COUNTER FOR LOW-LEVEL MEASUREMENT OF ALPHA ACTIVITY OF BIOLOGICAL MATERIALS. E.W.McDaniel, H.J.Schaefer and J.K.Colehour.
Rev. sci. Instrum., Vol. 27, No. 10, 864-8 (Oct., 1956).

A device has been developed for the alpha counting of solid materials of extremely low activity. It utilizes two identical detectors of novel design inside a common gas envelope and a programming mechanism to permit the automatic alternation of samples between the counters. The detectors are rectangular, screen wall, proportional counters which operate at an average background of 3.8 counts per hour. Thin, flat samples of 141 cm^2 area may be accommodated. A.

578.087.9 : 539.16

2879. INVARIANTS IN EXPERIMENTAL DATA ON LINEAR KINETICS AND THE FORMULATION OF MODELS. M.Berman and R.Schoenfeld.
J. appl. Phys., Vol. 27, No. 11, 1361-70 (Nov., 1956).

A new mathematical approach for the analysis of radioactive tracer experiments on compartmentalized systems in steady states is presented. The experimental measurements of the amounts of tracer in one or more compartments are approximated by a sum of exponential functions of time. The coefficients and exponential factors of these functions are shown to represent a set of invariants of the data. These are then related in a concise matrix equation to the compartmental model parameters, which are defined as the transition probabilities per unit time per unit quantity (turn-over rates) of molecules from one compartment (or state) into another. When measurements are incomplete, the freedom in choosing a model is expressed in terms of a minimum number of variables equal to the difference between the number of model parameters and the number of invariants found in the data. It is shown how other information regarding the model parameters or the amounts of material in steady state may be combined with the tracer data to reduce the degrees of freedom of a proposed model. Matrix transformations are worked out to allow the mapping of all mathematically consistent models in the configuration space of the minimum variables. The boundaries in this space corresponding to the limits for physically realizable models are found. Thus, a model is expressed by a set of coordinates and the values of all the parameters are obtained by substituting the values of the coordinates. Investigation of the range of variation of each parameter over the bounded region is also possible. A.

578.087.9 : 621.375.2

2880. A HEART PULSE AMPLIFIER AND RATEMETER. D.G.Wyatt.
J. sci. Instrum., Vol. 33, No. 11, 440–4 (Nov., 1956).

The self-biasing arrangement which is used in the amplifier greatly reduces the effects of changes in the mean level, shape, amplitude and duty cycle of the pulse. The ratemeter has rapid response and is suitable for continuous recording. A.

612.14

2881. SERVOMECHANISM FOR THE REGULATION OF BLOOD PRESSURE. N.Sager, J.H.Waite, J.W.Poppell and W.S.Howland.
Rev. sci. Instrum., Vol. 28, No. 1, 34-6 (Jan., 1957).

A blood pressure regulator for use in cases of shock, hypotensive anesthesia, and in medical research is described. The difference between measured and reference values of blood pressure is used to control the infusion rate of drugs acting on the cardiovascular system. Although the system is inherently nonlinear, it is stable when operated with restricted gain. A.

612.84

2882. ABOUT THE SPHERICAL ABERRATION OF THE EYE. A.Ivanoff.
J. Opt. Soc. Amer., Vol. 46, No. 10, 901-3 (Oct., 1956).

Results previously published (Ann. Opt. Ocul., Vol. 2, 97, 1953) have been corrected by providing data for spherical aberration within 0.5 mm of the achromatic axis. In general, as the eye accommodates, under-correction changes to over-correction. R.A.Weale

612.84

2883. SPHERICAL ABERRATION OF THE EYE AND THE CHOICE OF AXIS. M.J.Koomen, R.Scolnik and R.Tousey.
J. Opt. Soc. Amer., Vol. 46, No. 10, 903-4 (Oct., 1956).

Ivanoff's methods of obtaining and presenting results are criticized. R.A.Weale

612.842

2884. A STABILIZED RETINAL IMAGE OF THE IRIS. R.W.Ditchburn, D.H.Fender, S.Mayne and R.M.Pritchard.
Proc. Phys. Soc. B, Vol. 69, Pt 11, 1165-6 (Nov., 1956).

A description is given of a simple optical arrangement which enables one to see a stabilized image of one's own iris. R.A.Weale

612.843

2885. BLEACHING OF VISUAL PURPLE. J.C.Peskin and G.J.Miller.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1048-51 (Dec., 1956).

A seasonal alteration in the sequence of events in the bleaching of frog visual purple was re-investigated by alteration of the length of the light period in the normal diurnal cycle which the experimental animals were exposed. Frogs collected during winter and summer seasons were maintained on a light–dark sequence which corresponded both to the season of their collection and to the alternate season. The visual purple extracted from the retinas of the several experimental categories were exposed to light and the sequence of the bleaching reactions was followed. Comparisons were made upon the position of the isobestic point and the final products of bleaching. When the conditions of measurement, temperature, pH, and light exposure were constant seasonal differences did not appear, nor did the alteration of

the light–dark cycle result in any modification of the bleaching pattern. Changes in pH and light exposure cause changes in the bleaching pattern wich are identical regardless of season or alteration of the light–dark cycle. A.

612.843

2886. INDICATOR OF CONDITIONS OF ILLUMINATION. L.L.Dashkevich.
Svetotekhnika, 1955, No. 4, 5-7. In Russian.

This small instrument, which is intended for use together with a polarization binocular visibility meter, makes it simple and easy to determine characteristics directly associated with visibility, particularly the shadow-forming properties of illumination. A black spot and a matt white sphere are observed against a matt white background. Provision is made to determine the direction of the incident light. The visibility of the black spot (at constant distance) depends on the illumination of the screen, the observer's eye and the brightness distribution in the observer's field of vision. The visibility thus depends on the quality of the illumination in respect of brightness distribution (e.g. glare). The threshold of contrast of brightness for the given observer can also be determined for the given conditions of measurement. Measurements of the visibility of the matt white sphere against the standard white background can be used to evaluate the shadow forming properties of the illumination and its "contrastiness". Control measurements are required for the purpose of comparing measurements made at different times by different observers; the conditions, under which these control measurements should be made, are stated. W.R.Stoker

612.843.16

2887. VISUAL SENSITIVITY TO THE RATE OF ELECTRICALLY PRODUCED INTERMITTENCE. J.W.Gebhard, M.M.Duffy, G.H.Mowbray and C.L.Byham.
J. Opt. Soc. Amer., Vol. 46, No. 10, 851-60 (Oct., 1956).

Temporal resolution of the neutral and cortical components of vision was studied with periodic electric stimuli as a means of by-passing the photochemical retina. Difference-limens for discriminating the frequency of the faint flashes of light due to the passage of current through the eye were obtained at 13 frequencies between 5 and 45 c/s. The waveform of the periodic current was square with no d.c. component, and the current level was set by a method developed to produce electrical phosphenes of the same intensity at each frequency. Data from two observers give average deviations (ΔF) from the standard frequency (F) of 0.11 to 0.62 c/s. The relative difference-limens, $\Delta F/F$, lie between 0.009 and 0.03. Graphic integration of $1/\Delta F$ gives 127 just noticeable differences in the range studied. The graph relating ΔF and F shows to be a complex function of F. Recent data on the discrimination of photic intermittence also show ΔF to be a complex function of F, although of a quite different form in the frequency range between 15 and 40 c/s. These results with square waves of current are compared with earlier work on the differential sensitivity of the eye to the frequency of sine waves. A.

612.843.31

2888. CONCEPT OF DISTANCE IN AFFINE GEOMETRY. P.J.van Heerden.
J. Opt. Soc. Amer., Vol. 46, No. 11, 1000 (Nov., 1956).

It is suggested that von Schelling's metric (Abstr. 4130/1956) is a degenerated case of Cayley's metric. R.A.Weale

612.843.31

2889. REPLY TO P.J. van HEERDEN. H.von Schelling.
J. Opt. Soc. Amer., Vol. 46, No. 11, 1000-1 (Nov., 1956).

Hering's explanation of colour vision may be equivalent to a description of the three-dimensional hyperbolic space as seen from the enveloping five-dimensional Euclidean space. R.A.Weale

612.843.31

2890. THEORETICAL ANALYSIS OF ANOMALOUS TRICHROMATIC COLOR VISION. D.Jameson and L.M.Hurvich.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1075-89 (Dec., 1956).

Anomalous trichromatic colour systems are examined within the framework of a three variable, bimodal opponent-colour theory. Specific types of anomaly are assumed to be related to specific changes in the normal photoreceptor distributions and to impairments in the normal chromatic response processes. The aberrant colour equations, colour sensations, and colour discriminations of both protanomalous and deuteranomalous observers are shown to be meaningfully related to the postulated, systematically aberrant visual mechanisms. A.

612.843.31

2891. PREDICTION OF COLOR APPEARANCE WITH DIFFERENT ADAPTATION ILLUMINATIONS. R.W.Burnham, R.M.Evans and S.M.Newhall.
J. Opt. Soc. Amer., Vol. 47, No. 1, 35-42 (Jan., 1957).

Specifications are reported of colours which match in appearance with relatively complete adaptation to daylight, tungsten, and a third greenish illuminant. A computational procedure is described for predicting the colour appearance of everyday objects. This procedure is based on the known spectral character of the given object in relation to the appearance data presented here. Certain implications for colour vision theory are included. A.

612.843.31

2892. COMPARISON OF SUCCESSIVE WITH SIMULTANEOUS COLOR MATCHING. S.M.Newhall, R.W.Burnham and J.R.Clark.
J. Opt. Soc. Amer., Vol. 47, No. 1, 43-56 (Jan., 1957).

The two matching methods were compared to see whether they gave substantially different results. Such a difference would be of interest because successive matching is common in everyday life whereas simultaneous matching is standard colorimetric practice. An experiment was performed in which 25 test colours were matched by both methods. The successive or memory method yielded (1) the higher variability of replicative matchings, (2) the shorter matching times, (3) systematically higher purities, and (4) somewhat higher luminances. Three supplementary experiments are cited which are confirmatory with respect to the principal finding of extra purity and luminance usually required for the memory matches. This increased apparent strength of the remembered colours seems to be a direct consequence of the selectivity of memory. A.

612.843.31

2893. THE THEORIES OF COLOUR VISION. W.Müller-Limmroth.
Naturwissenschaften, Vol. 43, No. 16, 364-70 (1956). In German.

A review of the photochemical and electro-physiological foundations and hypotheses on which theories of colour vision are based. R.A.Weale

612.843.37

2894. ON THE VARIATION OF THE SUCCESSIVE DIFFERENTIAL LUMINANCE THRESHOLD AS A FUNCTION OF LUMINANCE IN THE SCOTOPIC REGION. R.Crouzy.
C.R. Acad. Sci. (Paris), Vol. 243, No. 13, 920-3 (Sept. 24, 1956). In French.

A frequency-of-seeing method was used to measure $\Delta L/L$ for $3.5 \times 10^{-6} < L < 3.5 \times 10^{-3}$ scotopic cd/m^2 in one observer. The data can be represented by two straight lines meeting at a minimum at $L = 2 \times 10^{-5}$ scotopic cd/m^2. The curve relating $\log \Delta L$ to $\log L$ also consists of two straight line portions, both of positive slope with a discontinuity at 2×10^{-5} scotopic cd/m^2. R.A.Weale

612.843.37

2895. INFLUENCE OF KNOWLEDGE OF TARGET LOCATION UPON THE PROBABILITY OF OBSERVATION OF PERIPHERALLY OBSERVABLE TEST FLASHES. J.J.Mertens.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1069-70 (Dec., 1956).

In measurements of the probability of observation of peripherally observable test flashes it has been found disadvantageous to have special attention for the direction in which the flashes can be seen instead of general attention for the whole visual field. A.

612.843.612

2896. VISUAL CONTRAST THRESHOLDS IN PRACTICAL PROBLEMS. J.J.Vos, A.Lazet and M.A.Bouman.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1065-8 (Dec., 1956).

Contrast thresholds — measured with dots and Landolt rings — are given as a function of object size and brightness for 31 observers. The desirability of presenting upper and lower limiting threshold curves is pointed out. Differences with the experiments of Blackwell are discussed. The influence of training is shown to be negligible. A.

612.843.613

2897. EFFECT OF SOME FACTORS ON THE VISIBILITY OF FLASH LIGHTS. K.N.Bulanova and A.V.Luizov.
Dokl. Akad. Nauk SSSR, Vol. 109, No. 3, 511-14 (1956). In Russian.

It was found that the length of period T of short periodic flashes has no effect on the relationship between the threshold brightness of the flash and its duration, at least within the T range 1-5 sec. For all background brightness values investigated the dependence of the threshold brightness quantity y and the duration of the flash τ is $y = a\tau + b$ ($y = E\tau$, i.e. the product of brightness and the duration at the visibility threshold). The parameters a and b depend almost exclusively on background brightness (and very little on the colour). F.Lachman

612.843.615

2898. THEORETICAL INVESTIGATION OF COLORED LENSES FOR SNOW GOGGLES. G.Wyszecki.
J. Opt. Soc. Amer., Vol. 46, No. 12, 1071-4 (Dec., 1956).

Safe driving or skiing in the "arctic whiteout" depends frequently upon the early detection of crevasses, fissures, ditches, or other sudden changes of elevation in the snow field. It has been believed that there might exist a certain coloured glass for snow goggles which would provide a better perception of dangerous spots in snow. However, no definite answer was available as to what colour the lenses ought to be. The purpose of this paper is to investigate this problem from the theoretical point of view. It is found that compared with an essentially neutral glass none of the coloured glasses ordinarily used in snow goggles improves the ability of the eye to detect sudden changes of elevation in a snow field. Even red glasses of extreme purity, which according to the present theory would be expected to give a maximum of improvement, are not significantly more effective than neutral glasses. A.

612.843.63

2899. STEREOSCOPIC ACUITY AND CONVERGENCE. R.A.Weale.
J. Opt. Soc. Amer., Vol. 46, No. 10, 907 (Oct., 1956).

It is suggested that differences in stereoscopic acuity as obtained in static and dynamic experiments are due to differences in the number of judgments made in the two types of experiment.

R.A.Weale

612.843.72

2900. CONSPICUITY OF FLASHING LIGHT SIGNALS: EFFECTS OF VARIATION AMONG FREQUENCY, DURATION, AND CONTRAST SIGNALS. S.J.Gerathewohl.
J. Opt. Soc. Amer., Vol. 47, No. 1, 27-9 (Jan., 1957).

This study deals with the conspicuity of flashing light signals of different frequencies, durations, and contrasts. It was planned to obtain information about the effects of these variables. The data show that at either high constrast or frequency, a change of the other factors does not produce a significant effect. At low contrast, however, conspicuity increases as flash frequency increases; and with low frequencies, conspicuity increases as brightness contrast increases. A.

612.846

2901. DETERMINATION OF THE STIMULI FOR INVOLUNTARY DRIFTS AND SACCADIC EYE MOVEMENTS. T.N.Cornsweet.
J. Opt. Soc. Amer., Vol. 46, No. 11, 987-93 (Nov., 1956).

Eye movements during monocular fixation were photographically recorded using the contact lens mirror technique. Records were taken during normal viewing and during viewing with a stabilized retinal image. Flicker was used to produce various durations of disappearance of the fixated figure under both conditions. Characteristics of the drifts and saccadic components of the eye movements were compared under these conditions. It was found that, (1) the rate of drift is the same for all conditions, (2) there are many fewer saccades during stabilized than during normal viewing, and (3) the frequency of saccades is independent of the duration of disappearance for stabilized viewing. An analysis of the characteristics of saccadic movements showed that their probability of occurrence, direction, and magnitude are dependent upon the position of the retinal image on the retina. No comparable relationship was evident for the drifts of the eye. Eye movement records taken in the dark indicate that, in the absence of visual control, the eyes are incapable of maintaining their fixation. Proprioceptive feedback, therefore, does not appear to play an important part in the fine corrective movements that serve to maintain ordinary fixation. It is concluded that the primary stimulus condition for involuntary saccadic eye movements is displacement of the retinal image on the retina, and that drift is the result of an instability of the oculomotor system. A.

612.85

2902. PITCH OF INHARMONIC SIGNALS. E.de Boer.
Nature (London), Vol. 178, 535-6 (Sept. 8, 1956).

A sound consisting of adjacent harmonics is perceived as having the pitch of the fundamental frequency. The pitch is to be attributed to a component of subjective perception, that is, the combined impression of some or all of the tones presented. Such a component, which is not susceptible to further aural resolution is called a "residue". This phenomenon has been studied by the use of an amplitude–modulation method which permits the use of inharmonic signals as well. It is concluded that the tone quality of the residue is greatly determined by the envelope of the signal and the pitch by the "fine structure". This simplified separation of phase and pitch effects is manifest in nearly all cases, except when the signal approaches the frequency-modulation condition. A.B.Wood

612.85

2903. VOWEL SOUNDS AND PERCEPTUAL CONSTANCY. D.E.Broadbent, P.Ladefoged and W.Lawrence.
Nature (London), Vol. 178, 815-16 (Oct. 13, 1956).

Describes an experiment on the subjective recognition of synthesized vowels. This confirms Joos' theory that the recognition of a vowel depends upon a comparison of its lowest two formant frequencies with those of vowels previously uttered by the same speaker, and not upon their absolute values. T.H.D.Attewell

TECHNIQUE. MATERIALS 62/69

667.6/.8

2904. METHOD FOR MEASUREMENT OF THE RATE OF DRYING OF SURFACE COATINGS. J.R.Jenness, Jr.
J. appl. Phys., Vol. 27, No. 11, 1371-3 (Nov., 1956).

By observation of rolling friction effects, the rate of drying of paints, varnishes and other surface coatings can be evaluated more precisely than by previous methods. The time of descent of a ball rolling down a coated incline has been proposed as an index of surface condition. The basic physical phenomenon involved, however, is rolling friction, so the coefficient of rolling friction would be preferable for use as a standard. A metric analogous to Brinell hardness can be defined from the coefficient of rolling friction. The ratio between the coefficient of rolling friction and the radius of the test ball is proposed as an index of surface condition. A.

669

2905. PROGRESS IN METAL PHYSICS. VOLUME 6. Edited by B.Chalmers and R.King.
London and New York: Pergamon Press (1956) viii + 354 pp.

For abstracts see Abstr. 1226, 1314, 1674, 1692, 1725, 1727 (1957).

669

2906. METALLURGICAL ASPECTS OF ATOMIC ENERGY. A SELECTED READING LIST. G.L.Cooper.
Atomic Energy Res. Establ. (Harwell) Inf. Bibl. 102, 14 pp. (1956).

The references are listed chronologically under the following headings: (1) General, (2) U, (3) Pu, (4) Th, (5) Be, (6) Zr, (7) Ceramic Materials, (8) Effects of Irradiation on Metals, (9) Liquid Metals, (10) Radioactive Tracers in Metallurgy. A.

669.04 : 548.7 : 548.53

ZONE-MELTING PURIFICATION OF BINARY COMPOUNDS.
See Abstr. 2794

LIST OF JOURNALS

The following list supplements the Lists of Journals published with the January number of Volume 56 (1953) and the Supplements published with the Indexes to Volumes 56 (1953), 57 (1954), 58 (1955) and 59 (1956). Copies of the numbers containing these lists can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Bull. Inst. Internat. Froid	Bulletin de l'Institut International du Froid (French/English Edition). Formerly issued in two editions (English and French) and referenced as: Bull. Internat. Inst. Refrig.
Proc. Chem. Soc.	Proceedings of the Chemical Society. Burlington House, Piccadilly, London, W.1.
Tech. Hausmitt. Nordwestdtsch. Rdfunks	Technische Hausmitteilungen des Nordwestdeutschen Rundfunks. Replaced by: Rundfunktechnische Mitteilungen [Rdfunktech. Mitt.]
Z. InstrumKde	Zeitschrift für Instrumentenkunde. F. Vieweg & Sohn, Postfach 185, Brunswick. Publication resumed in January 1957 with Vol. 65, No. 1.

NEW JOURNAL

Rdfunktech. Mitt.	Rundfunktechnische Mitteilungen. Institut für Rundfunktechnik, Mittelweg 113, Hamburg 13. Vol. 1, No. 1 dated February, 1957. Replaces: Technische Hausmitteilungen des Nordwestdeutschen Rundfunks [Tech. Hausmitt. Nordwestdtsch. Rndfunks] and: Mitteilungen des Rundfunktechnischen Instituts.

ERRATA

Abstr. 9350 (1955). This equation should read: "$\int_C \vec{A}\times d\vec{r} = \iint_S \{\vec{n}(\vec{\nabla}.\vec{A}) - (\vec{n}.\vec{\nabla})A - \vec{n}\times(\vec{\nabla}\times\vec{A})\ dS$."

Abstr. 166 (1957) line 3 : for "E.E.Guggenheim" read "E.A.Guggenheim".
Abstr. 514 (1957) line 14 : for "(about 450)" read "(about 4500)".
Abstr. 515 (1957) line 9 : for "six" read "sixty".
Abstr. 703 (1957) line 5 : for "A.P.Shabudin" read "A.F.Shabudin".
Abstr. 1207 (1957) line 4 : for "Ya.S.Babovich" read "Ya.S.Bobovich".
Abstr. 1157 (1957) line 3 : for "F.Pujolle" read "J.Pujolle".
Abstr. 2395 (1957) line 14: for "e^H" read "$|e|H$".

JOURNALS ABSTRACTED COMPLETELY

The following list gives the names of those journals whose contents, being entirely original contributions in Physics or Electrical Engineering, are currently being abstracted completely in one or other section of Science Abstracts (excepting short notes of transitory interest, articles already printed elsewhere, historical, commercial and organizational articles, news items and other non-scientific matter). This list supersedes lists published earlier.

Acta Electronica
Acta Physica Austriaca
Acta Physica Hungarica
Acta Physica Polonica
Acustica
Advances in Physics
Akustische Beihefte
Alta Frequenza
American Journal of Physics
Annalen der Physik
Annales de Physique
Annales de Radioélectricité
Annales de Télécommunication
Archiv der elektrischen Übertragung
Archiv für Elektrotechnik
Arkiv för Fysik
Australian Journal of Physics
Bell System Technical Journal
British Journal of Applied Physics
Cahiers de Physique
Canadian Journal of Physics
Czechoslovak Journal of Physics
Electronic and Radio Engineer
Electronics
Elektrichestvo
Frequenz
Helvetica Physica Acta
Hochfrequenztechnik und Elektroakustik
Indian Journal of Physics
Indian Journal of Theoretical Physics
Journal of the Acoustical Society of America
Journal of Applied Physics
Journal of Chemical Physics
Journal of Electronics
Journal of the Optical Society of America
Journal of the Physical Society of Japan
Journal de Physique et le Radium
Journal of Scientific Instruments
Nachrichtentechnische Zeitschrift
Nuclear Physics
Nuovo Cimento
Optica Acta
Optik
Philosophical Magazine
Physica
Physical Review
Proceedings of the Institute of Radio Engineers
Proceedings of the Institution of Electrical Engineers
Proceedings of the Physical Society
Progress of Theoretical Physics
Radiotekhnika
Reports of the Physical Society on Progress in Physics
Review of Scientific Instruments
Review of Modern Physics
Revue d'Optique
Scientia Electrica
Transactions of the American Institute of Electrical Engineers
Zeitschrift für angewandte Physik
Zeitschrift für Naturforschung (a)
Zeitschrift für Physik
Zhurnal Eksperimentalnoĭ i Teoreticheskoĭ Fiziki

An abstract is only published in Science Abstracts when an article or book is believed to be generally available. No abstracts are published of dissertations, reports, or memoranda with limited circulation, unless copies have been deposited with several public libraries; nor of papers presented orally at meetings, unless precis of substantial length are published in the normal way.

Thus the appearance of an abstract in Science Abstracts may generally be taken as an indication that the original is publicly available, and information for its identification and acquisition, if not given in the abstract, will be found in the List of Journals, or the annual or monthly supplements to it.

If no indication of language is given in the abstract, the article may be assumed to be in English. This does not necessarily hold, however, for abstracts reprinted from elsewhere, as indicate at the foot of the abstract.

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